Vol. 17 THIS NUMBER COMPLETES VOLUME 17 DECEMBER, 1946 No. 4

CHILD DEVELOPMENT

PUBLISHED QUARTERLY BY THE SOCIETY FOR RESEARCH IN CHILD DEVELOPMENT
NATIONAL RESEARCH COUNCIL
2101 CONSTITUTION AVENUE
WASHINGTON, D. C.
Made in United States of America

CHILD DEVELOPMENT

Vol. 17

DECEMBER, 1946

No. 4

Editorial Board

PUBLISHED QUARTERLY BY THE SOCIETY FOR RESEARCH IN CHILD DEVELOPMENT
NATIONAL RESEARCH COUNCIL
2101 CONSTITUTION AVENUE
WASHINGTON, D. C.
Made in United States of America

INDIVIDUAL GROWTH IN HIP WIDTH: A STUDY COVERING THE AGE PERIOD FROM 5 TO 9 YEARS BASED UPON *SERIATIM DATA FOR 55 NONPATHOLOGIC* WHITE CHILDREN

HOWARD V. MEREDITH and LOIS JEAN CARL
Iowa Child Welfare Research Station
State University of Iowa

There is need for "more studies relating to the growth changes of the individual" (1). This need is recognized not alone by research anatomists and physiologists (2, 3, 4, 5, 6, 7), but by every pediatrician and school physician interested in health appraisals which take into account the individual's "progress of growth" (8, 9).

The purpose of the present paper is to report a study pertaining to growth changes of the individual in hip width. The individual protocols analyzed extend over the four-year postnatal period from 5 to 9 years of age.

Five problems are investigated. The first is the form of individual growth curves. Here the question raised is whether all well children manifest a similar pattern of hip width growth or whether commonly found growth trends are of two or more different forms. The second problem relates to the hip width rank of the individual at successive ages. It is concerned with the validity of the assumption that a child who has narrow hips at age 5 years can be expected to have narrow hips at age 9 years, and vice versa. The third problem is that of deriving and analyzing year-by-year increments in the hip width. A central objective here is to afford normative materials which can be used as "frames of reference" both in experimental research and clinical practice. The fourth problem treats percentile gains in hip width over two consecutive bi-annual age periods and over the entire four-year period. Findings are presented indicating age, sex, and individual differences in rate of growth. The final problem considered deals with the relationship between hip width status and hip width increase. On this topic, the leading question posed is: do individuals who have wide hips at age 5 make large gains in hip width during the succeeding two or four years, and vice versa?

Subjects

The subjects were 55 white children - 35 males and 20 females - residing in or near Iowa City and attending the University of Iowa experimental elementary school. All were physi-

cally normal (one, Subject 9038, became moderately obese around 7 years of age) and all except one were born in North America (Subject 5327 was born in Germany).

From the standpoint of socio-economic status, the subjects represented an upward selection. Information on occupation of the father showed 76 percent to be professional men (mainly members of the University faculty), 20 percent business proprietors or managers, and the remaining 4 percent skilled or semiskilled employees. Another indicator of socio-economic selection upward lies in the choice of the University school - involving unsolicited application for enrollment, moderate tuition, and transportation expense.

Approximately 90 percent of the subjects were of northwest European ancestry. The principal exceptions were Subjects 1124, 1149 and 1157,[1] whose parents were born in Poland. No less than two-thirds of the subjects could be characterized as white children of "Old American stock," both of their parents and all four of their grandparents having been born in North America.

Each subject was examined at semiannual intervals during the period from 5 to 9 years of age.

Data

As may be seen from Table 1, the data consist of nine records for hip width on each of 55 children. Their accumulation took place over the years 1937-1946, some of the children being first measured in the fall of 1937 and others at later dates through the spring of 1942.

The procedure followed in obtaining the records was exceptionally rigorous. At each semiannual age hip width was taken independently by two anthropometrists. If these two measurements differed by more than 1 mm., both anthropometrists secured additional measurements. As a consequence, each record is highly dependable - representing either the mean of two measurements which differed by not more than 1 mm. or the median of no less than four measurements.

Hip width was determined in the region of the crests of the ilia, i.e., as bi-iliocristal diameter.[2] Using large aluminum sliding calipers (the Hrdlička compass), the distance was measured between the lateralmost point of the crest of the right

[1] *Subjects 1124 and 1157 were siblings, Subject 1149 a cousin.*

[2] *This dimension has been referred to by different investigators as bi-iliac diameter, intercristal distance, and pelvic breadth.*

TABLE 1

SERIATIM RECORDS FOR BI-ILIOCRISTAL DIAMETER (centimeters) ON 55 WHITE CHILDREN

Subject	Age in Years: 5	5½	6	6½	7	7½	8	8½	9
				Males					
130	18.30	18.70	19.10	19.55	19.90	20.25	20.55	20.85	21.15
216	19.60	20.10	20.50	20.85	21.15	21.45	21.75	22.05	22.35
724	17.30	17.60	17.95	18.30	18.65	18.95	19.20	19.50	19.75
892	18.60	19.00	19.45	19.95	20.40	20.80	21.15	21.55	21.95
1124	17.35	17.80	18.20	18.55	18.90	19.20	19.45	19.70	19.90
1149	18.55	18.85	19.15	19.50	19.90	20.25	20.60	21.00	21.40
2187	19.00	19.45	19.90	20.30	20.70	21.10	21.55	21.95	22.40
2755	18.40	18.85	19.25	19.65	20.05	20.45	20.80	21.05	21.30
2817	18.00	18.45	18.85	19.25	19.60	19.90	20.25	20.55	20.30
3057	18.10	18.45	18.80	19.10	19.40	19.70	20.00	20.35	20.80
3159	18.30	18.80	19.25	19.65	20.05	20.45	20.90	21.40	21.90
3572	17.80	18.25	18.65	19.05	19.55	20.00	20.40	20.85	21.20
3630	17.90	18.30	18.75	19.10	19.40	19.70	20.00	20.30	20.60
4277	17.80	18.15	18.50	18.90	19.30	19.75	20.20	20.65	20.95
4397	16.60	16.95	17.25	17.60	18.00	18.40	18.75	19.05	19.30
4438	17.25	17.65	18.05	18.40	18.75	19.10	19.45	19.80	20.15
4619	20.15	20.60	21.10	21.50	21.90	22.40	22.95	23.35	23.75
4716	17.90	18.25	18.65	19.10	19.50	19.85	20.15	20.40	20.65
4817	16.85	17.20	17.65	18.10	18.50	18.90	19.25	19.60	19.95
4938	19.25	19.75	20.25	20.70	21.10	21.75	22.40	22.90	23.30
5327	18.70	19.15	19.60	20.00	20.35	20.70	21.00	21.40	21.70
5374	16.55	16.85	17.15	17.50	17.95	18.20	18.55	18.90	19.25
5467	18.65	19.10	19.55	19.90	20.30	20.80	21.40	21.95	22.50
6003	20.00	20.45	20.95	21.45	21.85	22.25	22.65	23.05	23.45
6134	19.25	19.60	20.10	20.55	21.00	21.35	21.65	22.00	22.35
6206	18.95	19.45	19.95	20.35	20.80	21.25	21.70	22.15	22.50
6693	16.90	17.20	17.55	17.85	18.10	18.40	18.70	19.00	19.35
6718	16.95	17.30	17.60	17.95	18.30	18.65	19.00	19.30	19.60
6799	18.15	18.55	19.00	19.40	19.80	20.20	20.55	20.85	21.15
7056	17.40	18.00	18.60	19.00	19.35	19.60	19.80	20.05	20.35
7291	18.95	19.30	19.60	19.95	20.30	20.60	20.90	21.20	21.50
7393	17.95	18.40	18.85	19.25	19.60	19.90	20.25	20.55	21.00
9038	18.30	18.80	19.35	19.90	20.50	21.15	21.55	21.85	22.70
9582	18.75	19.35	19.85	20.30	20.70	21.05	21.40	21.70	21.95
9586	17.65	18.00	18.40	18.80	19.20	19.50	19.85	20.15	20.50
				Females					
211	18.00	18.50	19.00	19.35	19.65	19.95	20.25	20.65	21.05
383	18.35	18.70	19.10	19.50	19.90	20.30	20.65	21.00	21.40
424	16.90	17.20	17.45	17.70	18.00	18.40	18.80	19.20	19.70
753	18.60	18.85	19.15	19.45	19.80	20.20	20.70	21.25	21.70
1013	17.30	17.60	17.95	18.25	18.55	18.85	19.20	19.60	20.10
1157	18.80	19.20	19.55	19.95	20.30	20.70	21.10	21.55	22.05
1673	17.40	17.75	18.15	18.50	18.90	19.30	19.75	20.25	20.75
2049	18.10	18.65	19.15	19.70	20.20	20.65	21.15	21.70	22.25
2178	17.60	18.10	18.60	19.10	19.55	20.00	20.45	20.90	21.30
2318	18.10	18.50	18.95	19.30	19.65	20.20	20.80	21.30	21.75
2333	18.60	19.00	19.45	19.85	20.25	20.70	21.20	21.70	22.10
2678	18.10	18.55	18.95	19.35	19.75	20.10	20.50	20.95	21.40
4224	18.70	19.20	19.70	20.15	20.60	21.00	21.45	21.90	22.35
4746	17.20	17.55	17.95	18.45	18.95	19.45	19.95	20.50	21.10
4937	19.40	19.90	20.50	21.00	21.50	21.90	22.25	22.60	23.00
5413	18.15	18.55	19.00	19.50	20.00	20.55	21.10	21.70	22.25
7535	18.15	18.65	19.05	19.40	19.75	20.00	20.30	20.60	20.90
7735	17.75	18.15	18.50	18.80	19.15	19.45	19.80	20.15	20.50
8883	17.10	17.30	17.60	17.95	18.40	18.80	19.15	19.45	19.75
9358	16.80	17.50	18.10	18.55	19.00	19.40	19.80	20.40	21.00

ilium and the corresponding landmark for the left ilium. Always the subject was nude and oriented in the erect position with his weight equally distributed through both lower extremities. The anthropometrist stood in front of the subject and brought the face of each branch of the calipers squarely in contact with one of the landmarks. The maximum pressure was applied that could be exerted without pain to the subject.[3] In the event the subject turned his hips as the pressure was being applied, the measurement was retaken.

Findings

As indicated in the introduction, findings were sought on five facets of the problem of individual growth in hip width. These findings will be presented under the captions: Form of individual curves, Rank of individual at successive ages, Annual centimeter increase in hip width, Percentage gain in hip width, and Relationships between size and increment.

Form of Individual Curves

Leading question: Is there a single pattern of growth in hip width over the years from 5 to 9, or do different individuals manifest a variety of growth patterns?

The trend line of hip width on age was drawn for each of the 55 subjects. Age constituted the x-axis of these 55 graphs and hip width the y-axis. Each point plotted represented bi-iliocristal diameter (ordinate) at a given semiannual age (abscissa). The nine successive points for every individual were connected to yield individual curves - absolute magnitude trends - covering the age period from 5 years to 9 years.

Inspection of the curves gave the gross finding of all gradations in form or pattern from moderately convex, through linear, to moderately concave, together with a few somewhat more complex trends (e.g., convex-concave, concave-convex). Further intercomparison led to subdivision of the curves into four groups - linear, convex, concave, miscellaneous - and, subsequently, to the construction of Figure 1, which will be seen to utilize the data on 35 of the 55 individuals:

1. Section A presents 11 curves of a practically linear form. The representations of males (64 percent) and females (36 percent) are the same as for the total sample. Subjects 4224, 2049, 383 and 7735 are females.

[3] *Objective: firm compression of the soft tissues overlying the skeletal landmarks.*

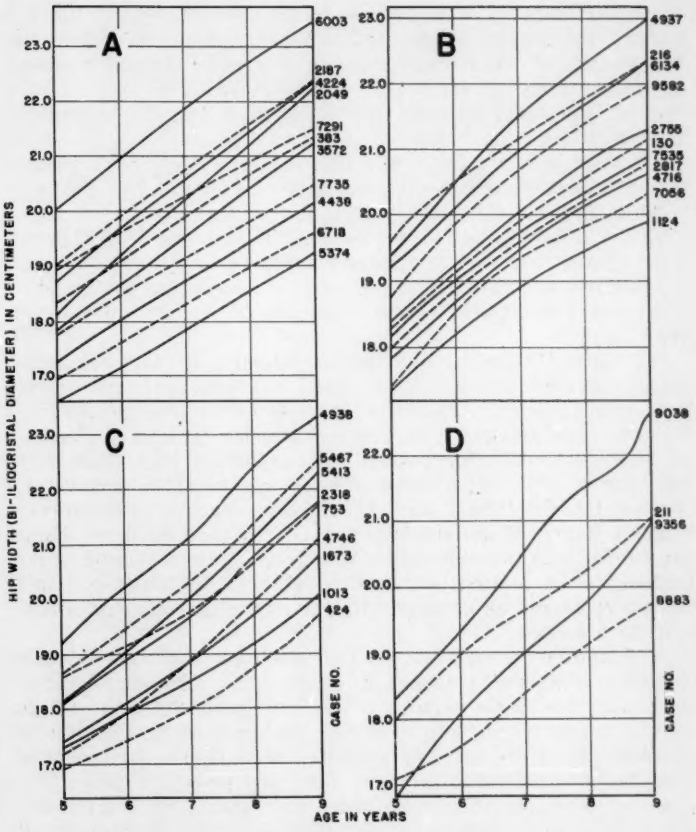

Figure 1. Four groups of individual curves for hip width extending over the age period from 5 years to 9 years. See the text of the paper for a description of each group and Table 1 for a listing of the values to which each curve was drawn.

2. Section B displays 11 curves of a generally convex form. In each instance the amount of rise from 5 to 7 years exceeds the amount of rise from 7 to 9 years by more than 0.3 cm. Four of the curves (4937, 9582, 7056 and 1124) ascend between 0.5 and 1.0 cm. more over the period 5 to 7 years than over the period 7 to 9 years. Convex trends occur with greater frequency among the males than the females: while females constitute 36 percent of the total sample, they constitute only 18 percent of Section B (4937 and 7535).

3. Section C portrays nine curves of a generally concave form. In each instance the amount of rise from 5 to 7 years is between 0.3 and 0.7 cm. less than the amount of rise from 7 to 9 years. Four of the curves (5467, 753, 2318 and 424) register a greater ascent over the latter biennium than over the former by upwards of 0.5 cm. More females than males are found to yield concave growth trends: the only males in Section C are 4938 and 5467.

4. Section D exhibits four curves placed in the miscellaneous group. Curves 211 and 9356 follow a convex-concave trend: both are females. The trend for 8883 (female) is concave-convex. Less marked concavity combined with greater convexity is registered in the pattern for the female 4937, Section B. The curve 9038 represents a male who became moderately obese in late childhood: part of its convex-concave form between 7 and 9 years of age might represent fluctuations in the compressibility of the subcutaneous adipose tissue overlying the landmarks. Attention is called to 4938 in Section C; possibly this curve should be grouped with the miscellaneous rather than with the concave.

It should be obvious that the four sections of Figure 1 do not illustrate discrete classes of curves. Sections B, A and C circumscribe three sectors of the continuum from a simple convex form through to a simple concave form. Section D presents the more extreme varieties of multiple-phase curves (i.e., trends composed of more than one growth cycle). The four sections together constitute an attempt to clarify and systematize the gradations found: they should not be interpreted as an attempt to minimize the intergrades.

Rank of Individual at Successive Ages

Leading question: Does the child who has wide hips at 5 years of age have wide hips at 7 and 9 years of age? Conversely, to what extent does the five-year-old child whose hips are narrow show a tendency at later childhood ages to maintain (or to change) his positional standing in the group?

Figure 2 displays curves for hip width (bi-iliocristal diameter) from 12 individuals. These curves were selected and arranged to illustrate constancy of position from age to age (Section A) and various combinations of marked divergence resulting from age to age shifts in rank (Sections B to F). The six sections of Figure 2 are conveniently discussed in alphabetic order:

1. Section A. Subjects 2187 and 6799 typify individuals who held approximately the same position in the hip width distributions for successive ages. At 5, 7, and 9 years, the percentile ranks of Subject 2187 fell between 84 and 86, those of Subject 6799 between 50 and 55. For roughly one-third of the subjects of each sex, the fluctuations in percentile rank over the years from 5 to 9 did not exceed five points. Additional instances are Subject 4619, with percentile ranks at 5, 7 and 9 years of 98; Subjects 6003 and 5374, with constant ranks at like ages of 96 and 2 respectively; Subject 4397, with ranks of 4 and 5; and Subjects 4937 and 4438, with ranks of 92 to 94 and 20 to 22 respectively.

2. Section B. Compared with Subject 2049, the hips of Subject 7291 were wider by 0.85 cm. at 5 years, practically equivalent at 7 years, and narrower by 0.75 cm. at 9 years. In terms of percentile rank, Subject 7291 underwent a downward change of 24 points (from 84 at 5 years to 60 at 9 years) and Subject 2049 an upward change of 27 points (from 50 at 5 years to 77 at 9 years). A similar relationship was found for Subjects 3057 and 2178, the former declining in percentile rank from 50 to 34 and the latter shifting upward from 28 to 53.

3. Section C. The hip widths of Subjects 216 and 5413 converged from a difference of 1.45 cm. at 5 years to almost no difference at 9 years. The percentile ranks at 5 and 9 were 94 and 81 for Subject 216, 54 and 77 for Subject 5413: It follows that the percentile rank differences decreased from 40 at 5 years to 4 at 9 years. Similar convergence over the same age period occurred for Subjects 2755 and 4746, the former decreasing in percentile rank from 66 to 53 and the latter increasing from 18 to 46.

4. Section D. Subjects 9356 and 6693 showed gradual divergence from hip widths that were alike shortly after 5 years of age to hip widths differing by 1.65 cm. at 9 years of age. These individuals had identical percentile ranks at age 5 years 2 months (ranks approximating 10) and gave a difference in percentile rank of 35 points at age 9 years (Subject 9356's rank was 41, that of Subject 6693 was 6).

5. Section E. The hip widths of Subjects 753 and 7535 converged during the sixth and seventh years and diverged during the eighth and ninth years. At age 5 the percentile ranks dif-

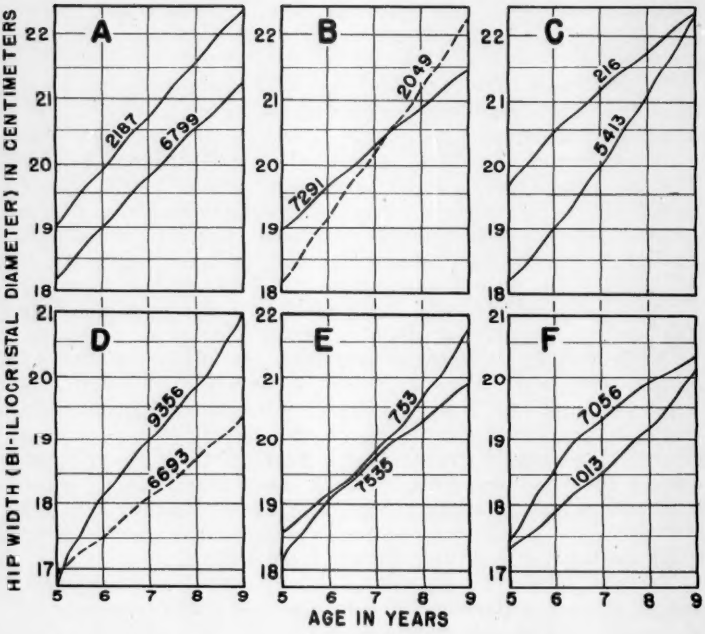

Figure 2. Twelve individual curves for hip width extending over the age period from 5 to 9 years. See the text of the paper for a discussion of each section of the graph and Table 1 for a listing of the values to which each curve was drawn.

fered by 22 points, at age 7 the differences were negligible, and at age 9 they differed by 27 points.

6. Section F. Subjects 7056 and 1013 diverged in hip width between 5 and 7 years and converged between 7 and 9 years. The differences in percentile rank were 4 at 5 years, 18 at 7 years and 4 at 9 years.

The purpose of Figure 2 and its complementary discussion has been to present selected instances of (a) constancy of rank and (b) marked change in rank. It is now pertinent to extend consideration of the problem of positional standing to the entire series of subjects. The tabulation which follows gives the frequency with which individuals were found to deviate in percentile rank by specified amounts.

Change in Percentile Rank	5 to 7 years		5 to 9 years	
	Number	Percent	Number	Percent
0 - 9	48	87	32	58
10 - 19	4	7	16	29
20 - 29	3	6	5	9
30 - 39			2	4

Individuals registering shifts in rank of less than 10 percentile points appear appropriately regarded as remaining "roughly constant." Employing this designation, roughly constant hip width ranks characterized more than four-fifths of the subjects over the two-year period from 5 to 7 and more than one-half of the subjects over the four-year period from 5 to 9. For the interval between 5 and 7 years, only 6 percent of the subjects underwent "marked change," i.e., registered shifts in percentile rank of 20 points or more. For the interval 5 to 9 years there were 13 percent whose positions in the hip width distributions showed "marked change." The maximum displacement for any individual was 35 percentile points, the equivalent of approximately one-third of the percentile distribution.

Two additional methods of analysis were considered helpful in elucidating the problem under study. One of these was the method of correlation. The other was the method of taking all the individuals making up some portion of the distribution for a given variable at a certain age and tracing their disposition in the distribution for the variable at some other age. Taking the individuals that constituted the middle 50 percent of the hip width distribution at 5 years, their dispersion in the distribution at 9 years was as follows: 6 percent were among the highest one-fourth, 38 percent among the central one-half, and 6 percent among the lowest one-fourth. Similarly for the individuals that constituted the middle 50 percent of the ordered series of hip widths at 9 years - in the distribution at 5 years, 6 percent

were among the highest fourth, 38 percent among the central half, and 6 percent among the lowest fourth. The product-moment coefficient of correlation (r) expressing the relationship between hip width at 5 years and hip width at 9 years was .90 ± .02.[4]

Annual Centimeter Increase in Hip Width

Leading questions: How much per year does the typical elementary school child increase in hip width? During a given annual age period (e.g., between 6 and 7 years of age) to what extent do physically normal individuals differ in their hip width increments?

For each of the 55 subjects, the difference was computed between hip width at age 5 and hip width at age 6. A like procedure was followed in obtaining centimeter gains in bi-iliocristal diameter for the yearly age periods 6 to 7, 7 to 8, and 8 to 9. The four series of increment values were then subgrouped according to sex, and the mean increase obtained for each sex during each successive year.

Sex	Number of Subjects	Age interval (years): 5 to 6	6 to 7	7 to 8	8 to 9
Males	35	0.84	0.78	0.74	0.71
Females	20	0.84	0.80	0.83	0.90

From this tabulation of the results, it will be seen:

1. The means for males and females representing the year 5 to 6 are identical.
2. There is a slight yet consistent decline in the male means from year to year.
3. For the age intervals 7 to 8 and 8 to 9, the female means are somewhat larger than the male means. The sex difference in centimeter gain during the latter year is statistically significant (t = 4.2).[5]

[4] The coefficients for each sex separately were males ($N = 35$) .94 ± .01 and females ($N = 20$) .84 ± .05.

[5] This finding, considered in conjunction with the earlier *timing in females of the so-called adolescent acceleration in hip* width, suggests *the possibility that the slightly* greater mean gains for females than males during the eighth and ninth years *reflect the gradual approach of at least some of the females to marked acceleration. The subjects are still being regularly examined and it is planned that a later study will follow their* growth through the high school years.

4. In general, the average yearly increase in hip width approximates 0.8 cm. for males 5 to 7 years of age, 0.7 cm. for males 7 to 9 years of age, 0.8 cm. for females 5 to 8 years of age, and 0.9 cm. for females 8 to 9 years of age.

Having epitomized the annual centimeter increments with reference to central tendency, we next subjected them to study from the standpoint of variability. In other words, findings were sought regarding individual differences in the amount of gain in hip width per year. Between the ages of 5 and 7 years (lacking any evidence of a sex difference in amount of gain) the data from both sexes were combined. For the succeeding two-year period (during which there was evidence of a slight tendency for females to gain more than males) the data from each sex were analyzed separately. The findings are presented in Table 2.

TABLE 2

ANNUAL INCREASE IN BI-ILIOCRISTAL DIAMETER (centimeters): Each row of the table designates an age interval, specifies the number of subjects studied, and affords four values describing the increment distribution. The subjects were white children of above average socio-economic status.

Age Interval (years)	N	Percentiles: Minimum	25th	75th	Maximum
		Both Sexes			
5 - 6	55	0.5	0.7	0.9	1.3
6 - 7	55	0.5	0.7	0.9	1.2
		Males			
7 - 8	35	0.4	0.6	0.8	1.3
8 - 9	35	0.4	0.6	0.8	1.2
		Females			
7 - 8	20	0.5	0.7	0.9	1.2
8 - 9	20	0.6	0.8	1.0	1.2

Generalizations which may be drawn include the following:

1. Over the age period from 5 to 7 years for both sexes, and from 7 to 8 for females, physically normal individuals occasionally gain as little as one-fifth inch per year (0.5 cm.) and as much as one-half inch per year (1.2 to 1.3 cm.). Fifty *percent of individuals gain between 0.7 and 0.9 cm., while one* child in four gains less than 0.7 cm. and one child in four more *than 0.9 cm.*

2. During the eighth and ninth years males tend to gain *slightly less than during the sixth and seventh years.* Twenty-five percent gain between 0.4 and 0.6 cm. annually, 50 percent

between 0.6 and 0.8 cm. annually, and the remaining 25 percent between 0.8 and 1.3 cm. annually.

3. In the case of females during the ninth year, one-fourth gain from 0.6 to 0.8 cm., one-half from 0.8 to 1.0 cm., and one-fourth from 1.0 to 1.2 cm.

4. During every year from the sixth through the ninth, individual differences among nonpathologic children are such that the hip width increases for some equal no more than one-half the increases of others. Conversely, the increments of a few are as much as twice those for a few others.

Percentage Gain in Hip Width

Leading questions: Does hip width at 9 years of age exceed hip width at 5 years by 5 to 10 percent, by 15 to 25 percent, or by 30 to 50 percent? Is the percentage gain in hip width greater between 5 and 7 years than between 7 and 9 years, or vice versa?

In obtaining an answer to the first question, values were derived expressing the gain (centimeter gain) of the individual between the ages of 5 and 9 years in terms of his size (actual hip width) at 5 years. The procedure was as follows: For each subject (a) the difference was calculated between hip width at 5 years and hip width at 9 years, (b) this difference was divided by hip width at 5 years, and (c) the resulting quotient was multiplied by 100 to put it in percentage form. The values obtained were grouped according to sex, ordered, and statistically reduced.

Age Interval (years)	Sex	N	Minimum	25th Percentile	Mean	75th Percentile	Maximum
5 - 9	Males	35	13	15	17	18	24
5 - 9	Females	20	15	16	19	20	25

The difference between the sexes was found to be significant at the 1 percent level of confidence ($t = 2.8$). In terms of hip width status at 5 years, the increases for males over the succeeding four-year period varied from 13 percent to 24 percent, with one-half falling between 15 percent and 18 percent, and the mean increase approximating 17 percent. For females, the mean percentage increment was around 19, the limits of the interquartile distance were 16 percent and 20 percent, and the extreme values 15 percent and 25 percent.

Turning now to the second question, two series of figures

were derived: one expressing the hip width gain of each individual between 5 and 7 years in terms of his hip width magnitude at 5 years, and the other expressing gain between 7 and 9 years in terms of size at 7 years. The procedure paralleled that described in computing percentage increments over the period 5 to 9 years. Prior to analysis the data for each biennium were subgrouped by sex. The results are shown in Table 3.

TABLE 3

PERCENTAGE GAIN IN HIP WIDTH OVER TWO ADJACENT BI-ANNUAL PERIODS

Age Interval (years)	N	Minimum	25th Percentile	Mean	75th Percentile	Maximum
			Males			
5 - 7	35	7	8	9	10	12
7 - 9	35	5	6	7	8	11
			Females			
5 - 7	20	6	8	9	10	13
7 - 9	20	6	7	9	10	11

Selected findings are:

1. For males the percentage increase in hip width tends to be higher over the period 5 to 7 years than over the period 7 to 9 years. The difference approximates 2 percent, and indicates a gradual decline in the growth rate with age. In the case of females the percentage increase is almost as great between 7 and 9 years as between 5 and 7 years.

2. Over the period from 5 to 7 years, the percentage-gain distributions of males and females are not appreciably different. For the succeeding biennium there is a statistically significant sex difference ($t = 3.7$), females tending to register systematically larger gains than males.

3. During the two years from 5 to 7, one-half of the subjects studied increased in hip width between 8 and 10 percent. The increases of the other half fell equally between 6 and 8 percent and between 10 and 13 percent. During the years 7 to 9, 25 percent of the males increased 5 to 6 percent and 25 percent of the females 6 to 7 percent; 50 percent of the males increased 6 to 8 percent and 50 percent of the females 7 to 10 percent; the remaining 25 percent each of males and females increased 8 to 11 percent and 10 to 11 percent respectively.[6]

[6]*These materials suggested inquiry into the relationship between an individual's percentage gain over the biennium 5 to 7 and his percentage gain over the biennium 7 to 9. Employing the method of correlation, it was found: for both sexes,* $r = .29 \pm .08$; *for males,* $r = .29 \pm .10$; *and for females,* $r = .29 \pm .14$.

Relationships between Size and Increment

Leading questions: Do individuals who have broad hips at age 5 make large gains in hip width over the years 5 to 7, or vice versa? What is the degree of association between hip width status at age 5 and increase in hip width between 5 and 9?

The hip width distribution for age 5 was separated into three parts - the upper one-fourth, the middle one-half, and the lower one-fourth. Similar three-segment subdivisions were made of the 5 to 7 and 5 to 9 distributions for centimeter gain in hip width.

Tabulation was then carried out to determine the frequency with which children in the highest quarter of the hip width distribution at 5 years were in (a) the highest quarter, (b) the central half, and (c) the lowest quarter of the distribution for gain in hip width from 5 to 7 years. Also determined was the mean gain between 5 and 7 for all subjects in the highest quarter of the distribution for age 5. In like manner analysis was extended successively to those in the middle half and in the lowest quarter of the hip width distribution at 5. Further, corresponding series of frequencies and means were obtained using, consecutively, the 5 to 9 year gains of those having (a) narrow, (b) medium and (c) wide hips at 5. The results are presented in Table 4.

TABLE 4

ASSOCIATION BETWEEN HIP WIDTH STATUS AT AGE 5 YEARS AND GAIN IN HIP WIDTH FROM 5 TO 7 YEARS AND FROM 5 TO 9 YEARS

Gain in Hip Width	Segments of Hip Width Distribution at Age 5: Lowest Quarter	Central Half	Highest Quarter
5 - 7 distribution:	%	%	%
Highest Quarter	13	19	43
Central Half	33	65	50
Lowest Quarter	54	16	7
	100	100	100
Mean Gain (cm.)	1.5	1.6	1.7
5 - 9 distribution:			
Highest Quarter	13	23	43
Central Half	40	58	43
Lowest Quarter	47	19	14
	100	100	100
Mean Gain (cm.)	2.9	3.2	3.4

It will be seen:

1. Individuals having narrow hips at 5 years (i.e., individuals in the lowest one-fourth of the age 5 distribution) made large, medium, and small gains between 5 and 7 years. A like finding accrues in the case of gains between 5 and 9 years for individuals with narrow hips at 5. Conversely, large, medium, and small gains from 5 to 7 and from 5 to 9 are found to occur among individuals having wide hips at 5.

2. There is a slight tendency for 5-year-old children with narrow hips to gain less over the succeeding two to four years than those with wide hips. Specifically, the mean gains between 5 and 7 for children in the lowest fourth, central half, and highest fourth of the 5-year hip width distribution are 1.5 cm., 1.6 cm., and 1.7 cm. respectively. Parallel mean gains over the period 5 to 9 years are 2.9 cm., 3.2 cm., and 3.4 cm. respectively.

3. Of the subjects constituting the lowest one-fourth of the hip width distribution at 5 years, 54 percent made small gains between 5 and 7, 33 percent medium gains, and 13 percent large gains. The percentages registering small, medium, and large gains between 5 and 9 years are 47, 40 and 13. Of the subjects constituting the highest one-fourth of the hip width distribution at 5, 43 percent made large gains between 5 and 7, 50 percent medium gains, and 7 percent small gains. The percentages showing large, medium, and small gains between 5 and 9 years are 43, 43, and 14.

The foregoing analyses lead to the generalization that there is not a high degree of relationship between the magnitude of a child's hip width at age 5 and the amount he gains in hip width during the succeeding two to four years. A succinct means of quantitatively expressing the relationship which does exist is available in the correlation coefficient. The product-moment method of correlation yields coefficients (r's) of .36 ± .08 for hip width at 5 with gain between 5 and 7 and of .31 ± .08 for hip width at 5 with gain between 5 and 9.[7] While these coefficients denote some degree of positive association between size and gain they are clearly too low to serve as useful media for predicting expected gain in an individual from a record of his size.

[7] *On males and females separately, the coefficients for size at 5 with gain from 5 to 7 were .48 ± .09 (males, N = 35) and .23 ± .14 (females, N = 20). For size at 5 with gain from 5 to 9 the corresponding coefficients were .50 ± .09 and .10 ± .15.*

SUMMARY

The subjects were 55 physically normal white children drawn predominantly from the professional and managerial classes. Each subject was examined at semiannual intervals between the ages of 5 and 9 years. At every examination a highly dependable record for hip width (bi-iliocristal diameter) was obtained. The total data (55 individuals measured at each of 9 equally spaced ages) consisted of 495 hip width records.

Findings are reported pertaining to five problems: the form or pattern of individual hip width curves; change with age in the hip width rank of the individual; normal variation in hip width increase per year; the rate of hip width growth for males and females; and, the degree of association between size of hips and amount of gain in hip width.

REFERENCES

(1) Ashley-Montagu, M. F. A cursory examination of the relations between physical and social anthropology. Am. J. Phys. Anthrop., 1940, 26, 57.

(2) Greulich, W. W., and Thoms, H. The growth and development of the pelvis of individual girls before, during, and after puberty. Yale J. Biol. & Med., 1944, 17, 91-97 + 8 plates.

(3) Shuttleworth, F. K. Standard of development in terms of increments. Child Develop., 1934, 5, 89-91.

(4) Davenport, C. B. The development of trunk width and the trunk width index. Human Biol., 1935, 7, 155-156.

(5) Simmons, K., and Todd, T. W. Growth of well children: analysis of stature and weight, 3 months to 13 years. Growth, 1938, 2, 115-134.

(6) Meredith, H. V. Stature of Massachusetts children of North European and Italian ancestry. Am. J. Phys. Anthrop., 1939, 24, 319-343.

(7) Shock, N. W. Physiological changes in adolescence. [In] Forty-third Yearbook of National Society for Study of Education, Part I, 1944, 56-79.

(8) Turner, C. E., and others. Rate of growth as a health index. Research Quart., Am. Phys. Educ. Assoc., 1935, 6, 29-40. (See also Am. J. Pub. Health, 1938, 28, 499-505.)

(9) Vickers, V. S., and Stuart, H. C. Anthropometry in the pediatrician's office. J. Pediat., 1943, 22, 155-170.

SKELETAL MATURING AS RELATED TO STRENGTH[1]

HAROLD E. JONES
University of California

The aspects of muscular strength which can be measured by dynamometers (static dynamometric strength) are of special interest to the student of child development. These functions are significant not merely as an outcome of their relation to other physical abilities, and of their role in many kinds of motor performance, but also because strength is often an important index to traits which, among boys in adolescence, occupy a high position in the hierarchy of social values (6).

Strength measurements are also characterized by extremely wide individual differences, and by an intense and prolonged spurt of growth during the puberal period. Table 1 and Figure 1 show growth curves from age 11 to 17.5 for Gripping Strength (Right and Left), Pulling Strength and Thrusting Strength.[2] The

TABLE 1

DYNAMOMETRIC STRENGTH MEASUREMENTS, BY AGE (Boys)

		Right Hand		Left Hand		Pull		Thrust	
Age*	N**	Mean (Kg.)	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
11.0	65	25.14	4.09	23.46	3.93	18.41	3.71	21.86	4.78
11.5	87	26.28	3.89	24.91	3.63	19.16	4.31	22.14	5.00
12.0	93	27.62	3.71	26.29	3.69	20.72	4.42	24.30	5.26
12.5	90	29.37	4.42	27.69	4.06	22.24	5.42	26.14	5.56
13.0	92	30.96	4.60	28.77	4.58	23.26	6.26	27.46	6.22
13.5	92	33.39	5.68	31.50	5.15	25.69	6.63	30.49	7.08
14.0	89	36.33	6.96	33.82	6.11	28.79	7.33	32.51	9.34
14.5	84	39.55	7.24	37.06	6.06	31.28	7.53	35.75	8.65
15.0	84	43.40	7.15	40.48	7.03	34.71	7.98	39.61	10.61
15.5	77	46.62	7.35	43.61	7.25	38.82	8.63	42.97	10.58
16.0	76	49.10	7.09	45.65	6.77	43.10	9.53	47.70	10.87
16.5	77	51.74	6.82	48.73	6.48	45.02	8.74	52.45	10.00
17.0	77	54.50	7.06	50.08	7.03	49.25	9.17	56.04	10.40
17.5	62	56.26	7.25	52.28	6.94	50.42	9.30	58.20	10.49

*The class interval is 10.75 to 11.24 etc.

**N is for the Right Grip measurements. Approximately the same sample is involved in the other measurements, except that at some ages two or three individuals who could be tested for one hand could not (due to minor injuries) be tested for the other hand, or on bi-manual tests.

[1]The materials included in this report are presented in greater detail in a volume now in press (7).

[2]The instruments and procedures in measurement are described in (7). In the test of Pulling Strength the dynamometer is held at chest level and the two hands pull outward or away from the midline of the body. In the test of Thrusting Strength the two hands push together in a compressing movement.

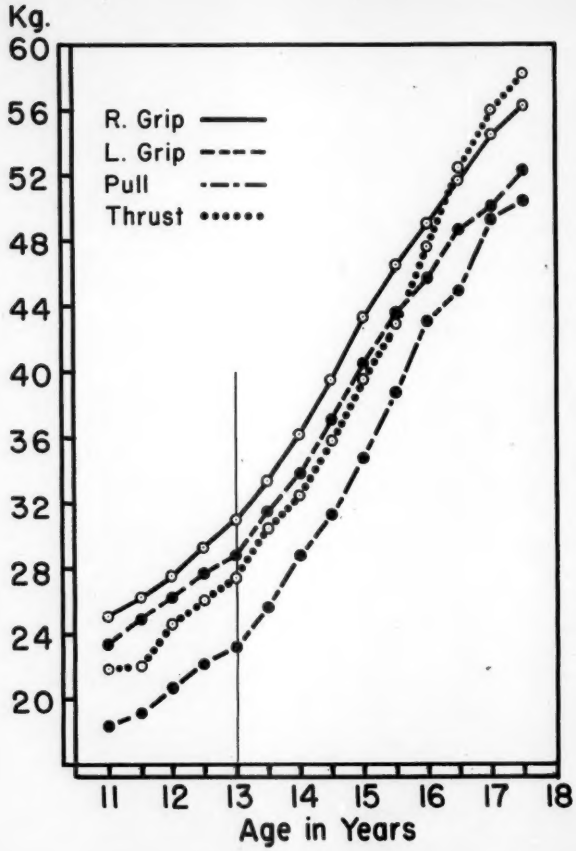

Figure 1. Average growth curves, for boys, in four functions.

sample consists of boys from the Adolescent Growth Study (4, 5) at the University of California, a normal sampling of cases from the Oakland Public Schools.

The curves in Figure 1 agree in showing an inflection at age 13. This is, clearly, the age which marks the beginning of the puberal growth spurt in strength. It is well known, however, that puberty occurs at different ages in different individuals. If the timing of the growth spurt is influenced by sexual maturity, it is probable that individual curves will diverge widely

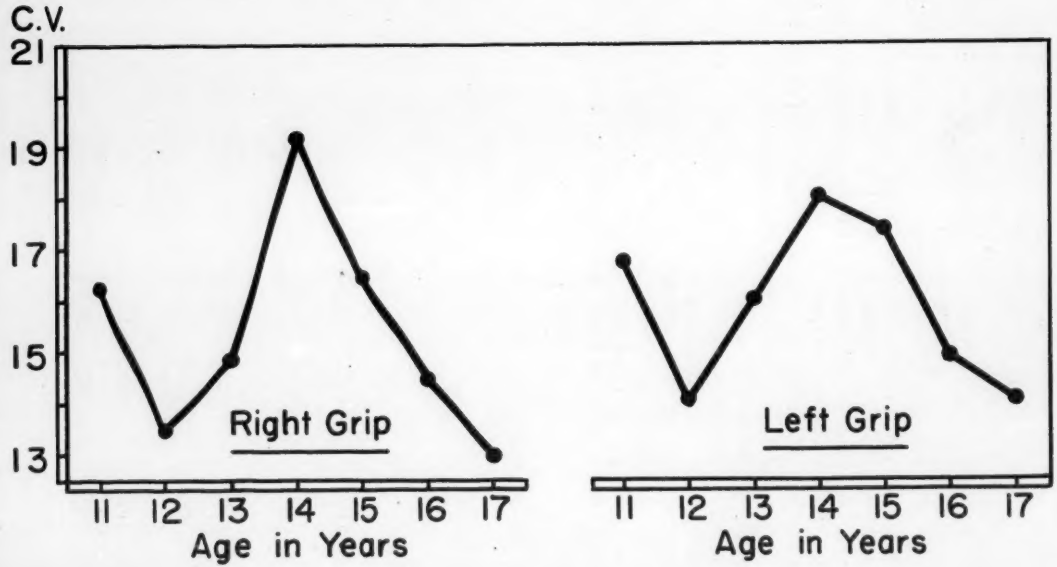

Figure 2. Age changes in the coefficient of variation for strength.

from the average curves shown in Figure 1.

The effect of such divergence should be seen, statistically, in measures of variability during the puberal period. Age changes in the coefficient of variation for strength are shown in Figure 2. Relative to the mean, the standard deviation declines from age 11 to 12; this is followed by an acceleration until a peak variability is reached at 14 years. It may be assumed that the recession after 14 represents a return to more normal variability, as an increasing majority of cases complete their growth spurt. The results reported here are similar to those previously found by Meredith (8) for Grip Strength. However, the hypothesis that changes in relative variability are produced by variable rates of maturing requires for its verification longitudinal records rather than the cross-sectional data employed by Meredith.

In the present sample, measurements of maturing are available in terms of x-ray measurements[3] of the hand and knee. In examining the effects of early and late maturing, average growth curves were prepared for boys classified in three groups as precocious, average, or retarded. The precocious and retarded are of course not a clinic sample; they represent approximately

TABLE 2

MEAN SCORES FOR EARLY, AVERAGE AND LATE MATURING (Kg., Right Grip)

Age	Early	Av.	Late
N:	16	28	16
11.0	27.1	24.0	22.7
11.5	29.3	25.9	25.2
12.0	29.3	26.9	26.0
12.5	31.3	28.4	27.0
13.0	33.3	30.4	28.1
13.5	37.6	32.5	30.0
14.0	44.2	34.3	30.2
14.5	47.1	38.6	33.3
15.0	50.0	43.0	36.3
15.5	52.2	47.6	41.1
16.0	54.3	49.0	43.9
16.5	55.9	50.9	48.4
17.0	57.2	53.5	51.5
17.5	—	55.8	54.3

[3] *These were made by Dr. Nancy Bayley. The method is described in (1).*

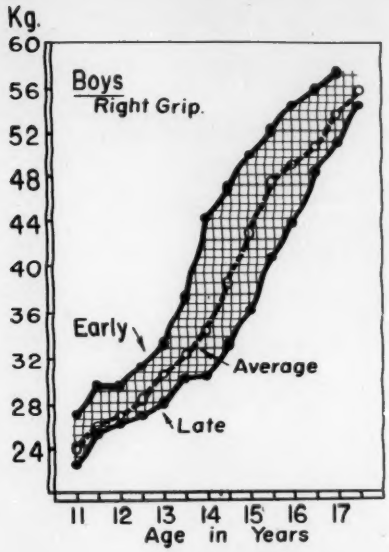

Figure 3. Growth curves for early-, average, and late-maturing boys, classified on the basis of skeletal ages.

the 20 percent at each extreme of a normal public school distribution. The "average" group consists of approximately the middle third of the cases, whose skeletal ages between 14 and 16 years coincided closely with the norms for boys of the same chronological ages.

The results are shown in Table 2 and Figure 3. It is apparent that in choosing different maturity groups we have obtained different strength groups as well. The differences between the early and late groups are significant at the 1 percent level.[4] The curves in Figure 3 are more or less parallel, with some divergence of the early- and late-maturing groups between the ages of 13 and 15, and with a later convergence which, however, fails to bring them together at the end of the series of measures.

[4] *At age 11, t = 3.6 (with 30 d.f.). At age 14.5, the time of maximum difference, t = 9.2. S.D.s for the early and late groups are 3.5 and 3.2 respectively at age 11; 7.8 and 6.1 respectively at age 14.5.*

TABLE 3

MEAN STANDARD SCORES FOR EARLY- AND LATE-MATURING BOYS (Right Grip)

Age	Early	Late
N:	16	16
11.0	55.2	44.4
12.0	55.1	45.1
13.0	56.1	44.3
14.0	61.7	41.7
15.0	58.5	40.7
16.0	57.4	43.4
17.0	53.9	45.5

Attention may be called to the fact that in this same sample of boys, the early-maturing are also larger in physical size than the late-maturing, at all ages from 11.7 to 17.7 years.[5] From the Harvard Growth Study, Shuttleworth (9) has reported that early-maturing boys (classified in terms of age at maximum growth) are superior in size to late-maturing boys. The difference in size is apparent as early as six years, and is maintained to the terminal measurements at 18 years.

It is unfortunate that, as yet, our data on strength do not extend to age 20 and beyond. However, in view of the tendency for the early-maturing to include more individuals of athletic (mesomorphic) build, and also in view of the tendency for earliness in maturing to be a factor in the development and maintenance of more athletic habits, it is highly probable that some average difference would be found to remain at adult ages.

The association of muscular strength and adolescent "status" is well known (6). Because of this relationship, it seems desirable to examine the growth of each maturity group in relation

[5]*Reference 2. See Figures 12-15, in this reference, for growth curves of height, stem length, bi-iliac diameter, and bi-acromial diameter. These growth curves, for early-, average, and late-maturing boys, are very similar in appearance to those for Right Grip.*

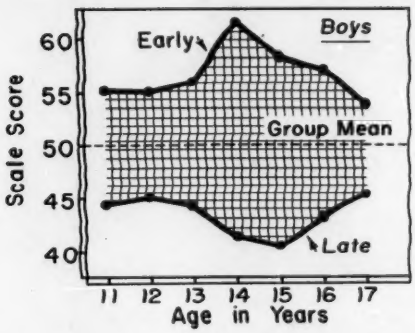

Figure 4. Standard score curves (right grip) for early- and late-maturing boys.

to the total group of boys of the same ages. Relative strength levels, and changes in these levels, are brought out more clearly when the strength scores in physical units are transformed into scale scores (relative to a group mean of 50, and a group S.D. of 10). This has been done in Table 3 and in Figure 4, presenting scale scores for the two extreme groups at annual intervals; in these curves, a rising line indicates a growth rate more rapid than the average, a falling line indicates a decelerating growth rate, relative to the average of that age.

The convex-concave form of curves for the early- and late-maturing cases provides a clear representation of contrasting growth patterns. As was shown in Figure 3, the early-maturing boys stand at all ages above the average.[6] But here more distinctly than in Figure 3, we note (among the early-maturing) an upward trend in relative growth rate from 13 to 14 years, with a peak at 14. The late-maturing, on the other hand, show a decline, relative to the average between the ages of 12 and 15; this is followed by a growth spurt, with a return toward the average after 15. At the beginning, and again at the end of the adolescent period, the early- and late-maturing boys are sepa-

[6] *Differences in Figures 3 and 4 in the position of the "average" line between the early and late maturing are due to the fact that in Figure 3 the average is based on a "typical" or "middle" sample whereas in Figure 4 the average is the mean of the total group.*

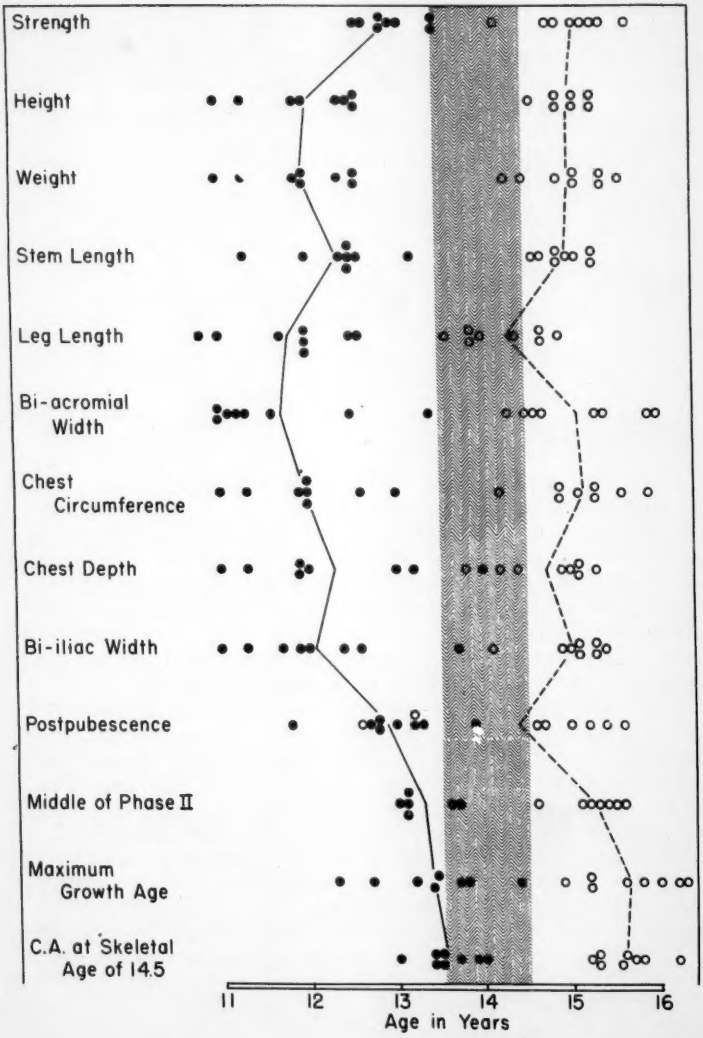

Figure 5. Profiles for maturity indices: Early- and late-maturing boys.

rated by about 1 S.D., but in the middle of the period, when the former have received the full benefit of their earlier growth impetus, the difference between the two groups becomes as great as 2 S.D., and can hardly fail to find representation in the traits related to strength.

For further study of growth curve relationships, eight cases at each extreme in the skeletal maturity classifications were selected for comparison as to a number of other criteria of maturing. These cases were a random selection of early- and late-maturing boys who had consecutive records from 11 to 16 years or later. Figure 5 presents this comparison in terms of the age of inception of the growth spurt in strength[7] and in a series of physical measurements.[8]

"Age of inception" was determined from the individual scale score curves, which usually show a clearer definition of short-term growth phases than is apparent in the average curves. In some instances the growth pattern is poorly differentiated, or has been disturbed to a confusing degree by such factors as seasonal variations. A further limitation lies in the fact that the measurements were taken only twice a year. Nevertheless, the early- and late-maturing boys (selected solely on the basis of maturity assessments of skeletal x-rays) prove to be sharply discriminated in the age of incidence of the growth spurt for strength and for the various size measurements. If the growth spurt had been more reliably determined (on the basis of more frequent cumulative records) it is probable that each group would show greater homogeneity in each variable, and that the two groups would be even more distinct than now appears to be the case. The most clear-cut, non-overlapping differentiation is in the growth spurts for height and weight, which are also the characteristics most reliably measured. Bi-acromial and bi-iliac width, and chest circumference and depth are less re-

[7] *In determining the growth spurt for strength, independent assessments were made and averaged for the four aspects of strength (Right and Left Grip, Pull, Thrust).*

[8] *Stem length (the distance from prominence of the tuber ischii to crown of the head) is a measure of the length of the trunk and head, obtained when the subject is sitting with his back against a vertical measuring board, his spine being forced into relatively vertical position by bending the knees so that the thigh is at a 45° angle from the floor. Leg length was determined by subtracting stem length from total height.*

Bi-acromial (shoulder) width and bi-iliac (hip) width are determined by means of sliding calipers applied, respectively, to the acromial points on the shoulders and the iliac crests on the hips.

liably measured, and no doubt this accounts at least in part for the poorer separation of the groups with respect to these variables.

In a study of the total sample of 93 boys from which these extreme groups were selected, Stolz (10) has shown that in the timing of growth spurts (the beginning of "Phase II" of the puberal cycle) a sequence can be recognized in which growth in leg length comes first, followed by bi-acromial and bi-iliac width, stem length, and strength. Among both the early- and the late-maturing, leg length clearly shows a growth spurt earlier than stem length or strength (among the individual records, this is evident in 13 of the 16 cases). The lag in the growth of strength is, however, more conspicuous among the early- than among the late-maturing. The latter tends to be "as strong as he looks." The former, at the age of 12 and 13, is not so strong as his height and weight would lead one to expect; nearly a year may elapse before functional efficiency, as manifested in strength, catches up with changes in size.

It has previously been noted (9) that the early-maturing tend to have a more sharply defined growth pattern than the late-maturing, i.e., their growth rates are greater at the peak of growth, and their phase changes in growth tend to be more sudden and more distinct. It is not surprising that they are subject to more marked discrepancies in the growth of different parts of the body, or in functional development (e.g. strength) as compared with the development of gross bodily structures.

The late-maturing, growing over a longer period, and with more gradual changes, may more readily succeed in adapting the various aspects of growth to each other, and in maintaining balance or congruence in physical development. Where such is the case, they escape some of the strains incident to early and rapid growth. This may not, however, compensate for the fact already noted that during several years in adolescence the late-maturing individual is so slow in realizing his physical potentialities that he tends to be handicapped in athletic competition and in status-relationships with others of the same age.

In addition to the variables discussed above, Figure 5 presents a comparison of the two groups of boys on four measures which are often used in assessing maturity. The first of these, "Postpubescence," is determined by the first appearance in the pubic region of terminal hair which is fully pigmented and which is marked by a wave or kink. Since the early studies of physiological age by Crampton (3), this criterion has been widely applied in classifying the physiological maturity of boys. It is apparent, however, that it fails to define our two groups satisfactorily; two individuals who are by all other indications late-

maturing fall among the early-maturing in their pubic hair ratings. It is also apparent that the development of pubic hair is influenced by factors other than those directly concerned in the maturing of body size. Among the early-maturing in this sample, postpubescence comes later than the inception of puberal growth in, for example, height and weight; among the late-maturing, on the other hand, it tends to accompany or even to precede the growth spurt in these variables. The physiological basis of such differences remains to be demonstrated, but it is apparent that factors associated with timing play an important role in the pattern of endocrine stimulation, as manifested in both (a) linear and ponderal growth and (b) the development of secondary sexual characteristics.

The "Middle of Phase II" is determined from assessments made by Stolz (10), based on the growth pattern for stem length and on accessory indications from the growth of the external genitals. For the total group of 93 boys, Phase II begins on the average at (approximately) 13 years, continuing to 16, with a middle point at 14.5. For the six early-maturing and seven late-maturing boys to whom this classification could be applied, the middle of Phase II falls respectively at 13.3 and at 15.1 years, and the two groups are well separated.

If, instead of the Phase diagnosis (which requires experience in assessing related data), the classification is made merely in terms of the mid-point of the age period in which the most rapid growth occurs in stem length, we obtain the results shown under "Maximum Growth Age," (on the average 13.4 years in the early-maturing, 15.7 in the late-maturing). Shuttleworth (9) has applied the maximum growth age (MGA) technique to various physical dimensions, with considerable success in discriminating groups of differing maturity. In the present sample, it is apparent that this criterion separates the early and late maturing into non-overlapping distributions, but each group is less homogeneous than might be desired. Inspection of Figure 5 indicates that a greater homogeneity, within each of the contrasting groups, is obtained by the Phase Criterion, and also by the growth spurt criterion in strength.

The final measure in this series, the chronological age at which a skeletal age of 14.5 was attained, should be expected to yield a good separation of the groups, since it is a part of the series of x-ray measurements on the basis of which the groups were originally segregated. In each group the Maximum Growth Age falls close to the time when a Skeletal Age of 14.5 is attained, no matter what the chronological age may be.

The inception of the adolescent growth spurt in strength occurs slightly earlier, at an average Skeletal Age of about 14.

The early-maturing are at this time 13 years old, on the average. It was shown in Figure 1 that the inflection in the strength growth curve for the total group occurs at 13 years. We now see that this is due to the contribution of early-maturing individuals in the group, and does not indicate that the average-maturing individual begins to grow rapidly in strength at this age. His inception point is more likely to be at 14, when his Skeletal Age is also 14.

SUMMARY

1. Average growth curves, from age 11 to age 17.5 years, were presented for four aspects of static dynamometric strength. Average curves, for boys, were approximately linear from 11 to 13 years, with an inflection to a more rapid rate of growth after 13.

2. Changes in homogeneity of the group, attributed to individual differences in rate of maturing, were shown by increases in the coefficients of variation between the ages of 12 and 14. This was followed by a decrease, as an increasing majority of cases completed their growth spurt.

3. The effects of differential maturing upon growth in strength were examined by comparing the growth curves of boys classified (on the basis of skeletal x-rays) as somewhat precocious, average or somewhat retarded. The early-maturing were significantly stronger than the late-maturing at age 11; their superiority continued until the terminal measurements at 17.5.

4. A comparison of the early- and late-maturing groups in terms of standard scores illustrated characteristic differences in relative growth patterns. The early-maturing showed an upward trend in relative growth rate from 13 to 14 years, followed by a decline. The late-maturing showed a lag, relative to the average, between the ages of 12 and 15, with a growth spurt after 15.

5. In a more detailed comparison of early- and late-maturing boys, it was found that among the former (but not the latter) the age of inception of puberal growth was later for strength than for most physical measurements. It was inferred that the more gradual nature of physical growth in the late-maturing permits a closer synchronization with physical aspects. The early-maturing experience more rapid, and in some respects less well integrated growth changes, but they often gain an early advantage in athletic competition and in associated prestige.

6. When the inception of puberal growth in strength is related to other criteria of maturity, it is found to occur at a

skeletal age of approximately 14 years (Todd). In both the early- and late-maturing it comes slightly after the first signs of postpubescence (Crampton), slightly before the middle of Phase II (Stolz), and about half a year before the maximum growth age in height (Shuttleworth). The discrimination of skeletally early- and late-maturing groups is clearest in the puberal spurts for strength, height and weight, and in the determinations of Phase II; it is least adequate in the assessments of postpubescence, suggesting a more limited validity of the latter measure in the determination of physiological age.

REFERENCES

(1) Bayley, N. Skeletal x-rays as indicators of maturity. J. Consult. Psychol., 1940, 4, 69-73.

(2) Bayley, N. Size and body build of adolescents in relation to rate of skeletal maturing. Child Develop., 1943, 14, 47-90.

(3) Crampton, C. W. Physiological age - a fundamental principle. Am. Phys. Educ. Rev., 1908, 13, Nos. 3-6. Reprinted in Child Develop., 1944, 15, 1-52.

(4) Jones, H. E. Principles and methods of the adolescent growth study. J. Consult. Psychol., 1939, 3, 157-159.

(5) Jones, H. E. Procedures of the adolescent growth study. J. Consult. Psychol., 1939, 3, 177-180.

(6) Jones, H. E. Development of physical abilities. Yearb. Nat. Soc. Stud. Educ., 1944, 43, Part I, 100-122.

(7) Jones, H. E. Motor performance and growth. Stanford Univ. Press, 1947.

(8) Meredith, H. V. The rhythm of physical growth. Univ. Iowa Stud. Child Welf., 1935, No. 3, pp. 128.

(9) Shuttleworth, F. K. Physical and mental growth of boys and girls age six to nineteen in relation to age at maximum growth. Monogr. Soc. Res. Child Develop., 1939, 4, No. 3, pp. vi+291.

(10) Stolz, H. R. Some physical aspects of development. Div. Child Develop. and Teacher Personnel of Teacher Educ. Comm., Am. Counc. Educ., 1940, (mimeographed), pp. 30.

AN ANALYSIS OF FOOD CONSUMPTION AND PREFERENCES OF NURSERY SCHOOL CHILDREN[1]

MINA WOLF LAMB and BING-CHUNG LING
Departments of Foods and Nutrition and of Child Development and Family Relations, Division of Home Economics
Texas Technological College

Introduction

With conscription of young Americans for the armed forces of the United States came the realization that the youth of the country are not in prime physical condition. This fact does not harmonize with the great abundance and variety of food produced in this country.

Authorities attribute the sub-optimum physical condition of American youth in a large measure to inadequate diet. Inadequate diet includes both the problem of the right kind and that of sufficient quantity of food. Much work is being devoted to determining what Americans are doing with their food supply; that is, what they are serving their families, what their likes and dislikes are, what the practices of handling foods in the home are, and similar problems. Additional investigations are being conducted on the effect of the food supply on the nutritional status of Americans; namely, what the concentration of nutrients in the blood stream is, what relationship exists between the food intake and the nutritional status of the person, what criteria we have for measuring early signs of nutritional inadequacy, what other factors besides food intake affect the nutritional status and physical development of a person.

That no adult can attain a higher state of physical fitness than his early developmental history permits is an established

[1]*This investigation was made possible through grants from the Research Fund of Texas Technological College.*

The study is a part of the comprehensive research entitled *"The psychophysical development of the preschool child."* Three parts of this research have been published: *(1) Lamb, M. W. Basal metabolism of eight nursery school children determined at three-month intervals. Am. J. Dis. Child. 70, 220-225, 1945.* (2) Ling, B. C. *The solving of problem-situations by the preschool child. J. Genet. Psychol. 68, 3-28, 1946.* (3) Ling, B. C. The adaptation of the preschool child to standard basal *metabolism conditions. J. Genet. Psychol. 68, 29-44, 1946. Other parts are in preparation. When completed, the entire research will be published as a unit.*

fact. Physical handicaps developed from malnutrition in childhood cannot be overcome completely but will show their effect at various times during adulthood. Furthermore, health records of adults show that their sub-optimum physical condition is not the result of their immediate practices but rather of the accumulation of long-time abuses. The poor teeth, imperfect eye sight, and prevalence of infectious conditions recorded in the examinations of conscriptees are not the result of dietary and health practices of the previous month, but can be attributed to inadequate dietaries and health habits of childhood. One must, therefore, understand the nutritional practices of the child in order to understand better the physical state of the adult and the probable causes for deviations from the optimum.

Purpose

The following study is an attempt to gain insight into the nutritional practices of the child by analyzing his food consumption and preferences. It is fivefold in its purpose.

1. To determine the food consumption and nutrient intake of normal nursery school children.
2. To determine the adequacy of these intakes by comparison with accepted dietary standards for these subjects.
3. To study the food preferences of these subjects by analyzing their affective concomitant during food intake.
4. To study the influences of the food preferences on the adequacy of their diet.
5. To observe any relationship between the food consumption and the results of pediatric and dental examinations made on these subjects.

Experimental Procedure

The subjects were 8 children, 5 boys and 3 girls, from the Nursery School of the Department of Child Development in the Division of Home Economics of Texas Technological College. They were selected at random from applications for admittance to the Nursery School. Their ages ranged from 2 years, 2 months to 3 years, 7 months. They were normal healthy children from homes varied in living standards, yet limited to the so-called middle class of citizenry.

The mothers and nurses of the subjects were informed in advance of the plans of the study and instructed in the recommended procedure for keeping records in order to insure uniformity of data and whole-hearted cooperation. Standard equipment accurate to a fourth of a teaspoon was furnished to

measure the food consumed by the subjects both at home and in the Nursery School. No control was exercised over the menus used in the feeding of each subject.

Daily records, both of food consumed and of affective concomitant during the food intake, were kept for one week at 3-month intervals starting October 7, 1942 and ending October 20, 1943. The food-intake records include the amounts of food consumed as well as the ingredients used in the preparation of "made-dishes."[2] The affective concomitant data classify the emotional responses of the subjects to each dish into the following 5 categories:

1. VP = very pleasant, when the child expressed his hearty approval of the dish by exclamations of joy upon seeing and tasting it, by consuming the content with alacrity, and often by asking for a second serving.

2. P = pleasant, when the child consumed the dish cheerfully and in good time. Sometimes the process was accompanied by such remarks of approval as "I like this." or "It's good!"

3. N = neutral, when the child ingested the food upon request. He showed neither signs of relish nor those of protest. He was matter-of-fact in the process.

4. U = unpleasant, when the child consumed the food only under protest. Often he dawdled and refused to empty the dish. Such utterances as "I don't like this." or "I am full." were common.

5. VU = very unpleasant, when the child refused completely to taste the food. If urged, he tended to show strong emotional outbursts. If left alone, he might sit by the hour before the dish without attempting to consume it.

In this connection it is important to note that the subjects did not have before them a whole array of dishes from which to choose during any meal. What they were to eat was prescribed by their mothers or nurses while at home and by teachers and cook while at the Nursery School. However, they were free to express their preference for a given dish by their affective concomitant during the consumption of that dish. It may also be well to point out here, by way of emphasis, that the assignment of any of the 5 types of affective concomitant to a given reaction to a specific dish was based upon the total behavior pattern of the subject.

At home the mother or the nurse of the subject served as observer and recorder. In the Nursery School one of the experimenters took charge of affective concomitant records for all

[2] By "made-dishes" is meant all those dishes prepared by a combination of various foods not specified in standard recipes.

subjects, while student assistants, under careful supervision of the other experimenter, measured as well as recorded the food consumed. Both types of records were checked for their specificity and accuracy at the close of each experimental week.

Occasionally record taking for a subject had to be postponed for a few days because he was ill or out of town. At the completion of the third experimental week Cases IV and VIII left town, while the mother of Case II discontinued her participation in the project because she found the task too tedious. Thus, 3 subjects had only 3 weekly food consumption and affective concomitant records, whereas 5 completed the study with 5 records each.

Heights and weights of the subjects were recorded to the nearest tenth of an inch and of a pound[3] respectively for each experimental week. Dental and pediatric examinations were made by experts in those professions[4] in November, 1942, April, 1943, and January, 1944. These records were kept in order to ascertain the well-being of each subject throughout the entire study.

Treatment of Data

I. Food consumption records

Data on the amounts of food consumed by each subject were compiled for each weekly period, and the nutritive value was calculated according to average compositions given by Taylor (1). The nutritive value of "made-dishes" not given by Taylor was computed on the basis of percentages of the ingredients in the dish. No consideration was given to the influence of the area of the country on the amounts of nutrients in foods or on practices of preparation.

The average weekly food intake of the subjects was obtained by classifying the foods into 11 groups[5] and by compiling the weights of foods in each class for each of the 5 experimental weeks. All 5 of the weekly food-group intake records were

[3] *These measurements were converted to centimeters and kilograms respectively.*

[4] *Dr. G. C. Turner, orthodontist, and Dr. M. C. Overton, head pediatrician of Lubbock General Hospital, were kind enough to examine the subjects at the intervals specified by the experimenters.*

[5] *These groups are those used in the weekly Family Food Plans as published by the U. S. Dept. Agric. AWI-78, 1943.*

averaged for each subject for the experimental year.

II. Affective concomitant records

Data on the affective concomitant of the subjects during the food intake were analyzed first on the basis of preference and then on the basis of learning. To attain the former objective all the dishes consumed by the subjects were classified into 13 major divisions; namely, (1) meats, (2) fish, (3) fowl, (4) eggs, (5) dairy products, (6) vegetables, (7) fruits, (8) cereal products, (9) food combinations, (10) custards, puddings, and gelatin desserts, (11) concentrated sweets, (12) pharmaceutics, and (13) miscellaneous food items. Each of these major divisions was then further divided into subdivisions, groups, subgroups, and units. Every food item within the same unit was analyzed according to the methods employed in the preparation and the ways of serving it. At every step of the classification the affective responses of each subject were compared among themselves, as well as with those of the other subjects, in order to ascertain both individual and group reactions to food in general, to a specific class of food, to a specific food item, to a specific dish, and to a specific way of serving that dish.

To analyze the learning process involved in the food preference of the subjects the affective concomitant data were compiled for the group for each of the 5 experimental weeks. Then all the food consumed by each subject during each week was treated, first as a unit, later under the 13 major food divisions. Finally, the affective response of each subject to any dish which had appeared more than once in his weekly menus over two or more experimental weeks was analyzed in order to determine different types of learning involved.

In order to compare the relative acceptability of two or more dishes, food items, or divisions to a given subject or to the entire experimental group, two very simple methods of computation were devised. The first was called the percentage of frequency method. In it the number of times in which a particular dish (or food division) was judged very pleasant, pleasant, neutral, unpleasant, or very unpleasant was divided by the total number of times in which that particular dish (or food division) was served to the subject (or the experimental group). The result thus obtained was then compared with that of another dish (or food division) similarly treated.

The second method was referred to as the rank score method. It consisted of 4 steps:

Step 1. Assuming that the degree of affection between any two members of the 5 types of affective concomitant was equal,

numerical values were assigned as follows:

VP = 1
P = 2
N = 3
U = 4
VU = 5

Step 2. Each of the numbers obtained in Step 1 was multiplied by the frequency with which a given dish (food item or division) was judged very pleasant, pleasant, neutral, unpleasant, or very unpleasant.

Step 3. All the products obtained in Step 2 were added.

Step 4. The sum just obtained was divided by the total frequency with which the dish (or food division) in question appeared in the dietary of a given subject (or of the entire experimental group). The quotient was the rank score for that food for the subject or subjects under consideration.

A rank score obtained by the above method of computation does not only indicate the relative acceptability of one food as compared with another, but it also gives an accurate estimation of its absolute acceptability. For instance, a rank score of 1.20 means that the food in question is judged not only as much more acceptable than another food having a rank score of 3.50, but is, on the whole, very pleasant to the subject or subjects concerned.

III. Physical status records

From the data on the heights and weights of each subject throughout the experimental period the normalcy of his weight for his height and age, according to the standard developed by Woodbury (2) was determined. For children, normalcy of weight means their weight coming within plus or minus 10 to 15 percent of the average weight for his height and age. The dental and pediatric examination records were analyzed and those parts related to the nutritional status of the subject correlated qualitatively with the results on food consumption and preferences.

Results

I. Food consumption

A. Consumption of individual nutrients

A study of the average daily nutrient intake of the subjects recorded in Table 1 brings out the following impressive facts:

1. Large quantities of vitamins and mineral elements are

TABLE I

AVERAGE DAILY CONSUMPTION OF NUTRIENTS AS CALCULATED FROM ONE WEEK'S DIETARY TAKEN FOR A YEAR AT THREE-MONTH INTERVALS

Case	Sex	Age	Average daily consumption of nutrients: Calories	Protein	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Absorbic acid
		yr. mo.		gm.	gm.	mg.	I.U.	mg.	mg.	mg.
I	F	2 2	1063	44.9	1.49	6.0	3,052	0.51	2.38	96
		2 5	1158	48.9	1.81	7.0	18,018*	1.00	3.83	84
		2 8	1068	39.1	1.09	5.9	15,645*	0.42	2.15	76
		2 11	1061	43.7	1.17	4.7	3,118	0.63	2.18	64
		3 2	1106	43.1	1.06	5.5	3,572	0.76	2.06	75
		Average	1091	43.9	1.32	5.8	8,681	0.66	2.52	79
II	M	3 3	1287	52.1	1.29	36.8*	22,802*	1.39	3.02	129
		3 6	1205	49.1	1.23	7.0	16,311*	0.89	2.49	118
		3 9	1186	49.1	1.25	5.9	20,535*	0.81	2.45	107
		Average	1226	50.1	1.26	16.6	19,883	1.03	2.65	118
III	M	3 7	1023	47.8	0.59	6.5	4,684	0.75	1.31	113
		3 10	1079	45.1	0.73	8.8	4,316	0.83	1.63	103
		4 1	1416	55.4	1.13	7.7	5,753	0.98	2.20	94
		Average	1173	49.4	0.82	7.7	4,918	0.85	1.71	103
IV	F	3 5	1373	40.4	0.80	7.1	8,936*	0.66	1.83	62
		3 8	1181	41.7	1.00	7.4	7,005*	0.81	2.00	91
		3 11	1414	48.0	1.10	7.9	5,504	0.86	2.15	80
		4 2	1371	51.8	1.17	6.7	4,398	0.70	2.19	39
		4 5	1529	52.8	1.35	7.2	5,617	0.83	2.59	70
		Average	1374	46.9	1.08	7.3	6,292	0.77	2.15	68
V	F	3 3	1113	43.0	0.87	5.3	3,338	0.68	1.73	85
		3 6	1101	47.1	0.97	6.5	22,144*	0.76	1.93	98
		3 9	1058	45.2	0.92	6.3	8,984*	0.72	1.90	74
		4 0	1041	40.1	0.86	5.3	11,828*	0.60	1.72	41
		4 3	1076	44.2	0.82	6.1	4,115	0.76	1.85	41
		Average	1078	43.9	0.89	5.9	10,082	0.70	1.83	68
VI	M	3 4	1169	56.6	0.81	7.4	3,838	0.98	1.70	49
		3 7	1137	45.5	0.93	7.5	4,295	0.84	1.87	99
		3 10	1112	41.6	0.97	6.6	5,281	0.80	1.95	72
		4 1	1447	60.4	1.18	10.0	4,484	1.08	2.86	52
		4 4	1223	50.1	1.01	7.9	4,252	0.81	2.07	79
		Average	1217	50.8	0.98	7.9	4,430	0.90	2.09	70
VII	M	3 6	1400	42.9	1.11	10.2	15,186*	0.95	2.58	58
		3 9	1035	41.2	0.98	6.9	4,449	0.81	1.99	114
		4 0	1283	31.6	1.17	7.5	4,244	0.83	2.34	73
		4 3	1323	54.1	1.11	7.5	7,481	0.73	2.10	39
		4 6	1392	44.3	0.99	6.7	4,729	0.72	2.05	57
		Average	1287	42.8	1.07	7.8	7,218	0.81	2.21	68
VIII	M	3 3	1425	50.5	1.49*	10.5	3,831	0.88	0.92	128
		3 6	1329	58.7	1.50*	12.1	21,256*	1.18	1.15	122
		3 9	1521	128.0	0.45	11.0	5,947	1.14	1.23	158
		Average	1425	79.1	1.15	11.2	10,345	1.07	1.10	136
Standard: Recommended daily allowances by the National Research Council, revised, 1945.										
		1-3 yrs. to 4-6 yrs.	1200 1600	40-50	1.0	7-8	2,000 2,500	0.6 0.8	0.9 1.2	35-50

*Concentrate of nutrient given.

TABLE 2

AVERAGE WEEKLY FOOD CONSUMPTION OF SUBJECTS

Kinds and quantities of food consumed per week

Case	Sex	Age	Milk	Potatoes, sweet & white	Dry beans peas, & nuts	Citrus fruits, tomatoes	Green & yellow vegetables	Other vegetables & fruits	All meats	Cereal products	Fats	Sugar products	Eggs
		yr. mo.	qt.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	no
I	F	2 2	7	0 3	0	0 12	0 8	2 7	0 12	0 11	0	0	1
		2 5	8	0 3	0	1 8	0 9	1 2	0 6	0 10	0 1	0 2	0
		2 8	6	0 3	0	1 6	0 11	2 5	0 5	0 11	0 1	0 1	0
		2 11	6 3/4	0 3	0	1 5	0 4	0 7	0 8	0 13	0 1	0 1	0
		3 2	5 3/4	0 5	0	2 1	0 4	1 2	0 11	0 12	0	0	2
		Average	6.7	0 3.4		1 5.4	0 7.2	1 7.8	0 8.4	0 11.4	0 0.6	0 0.8	0.6
II	M	3 3	6 3/4	0 5	0	3 5	0 10	1 10	0 6	0 14	0 1	0 1	4
		3 6	6 1/2	0 5	0	2 14	0 8	2 1	0 12	1 2	0 1	0	4 1/2
		3 9	6 3/4	0 5	0	2 4	0 6	1 3	1 3	1 7	0	0 1	3
		Average	6.7	0 5.0		2 13.0	0 8.0	1 10.0	0 12.3	1 3.0	0 0.7	0 0.7	3.8
III	M	3 7	9	0 2	0	3 5	1 1	1 14	0 12	2 0	0 1	0 1	1
		3 10	3 3/4	0 6	0 1	2 5	0 3	2 0	1 1	2 0	0 1	0 5	10
		4 1	6	0 9	0	2 13	0 7	0 8	1 10	4 0	0 1	0 5	4
		Average	6.2	0 5.7	0 0.3	2 13.0	0 9.0	1 7.3	1 2.3	2 10.7	0 1.0	0 3.7	5.0
IV	F	3 5	4	0 8	0	1 9	0 1	2 5	0 12	2 12	0 4	0 3	5 1/2
		3 8	4 3/4	0 3	0	2 11	0 2	0 14	0 4	2 12	0 1	0 5	4 1/2
		3 11	5 1/2	0 7	0	2 0	0 4	0 8	0 5	2 7	0 5	0 3	4 1/2
		4 2	6	0 13	0	0 11	0 4	0 12	0 11	2 12	0 2	0 7	3 1/2
		4 5	7	0 6	0	1 10	0 7	0 13	0 5	2 2	0 6	0 4	7
		Average	5.4	0 7.4		1 11.4	0 3.6	1 0.8	0 7.4	2 9.0	0 3.6	0 4.4	5.0
V	F	3 3	4 1/2	0 5	0 2	2 4	0 2	1 9	0 12	1 1	0 1	0 4	5 1/2
		3 6	5 1/4	0 3	0	2 13	0 6	0 10	0 8	1 1	0 3	0 3	4 1/2
		3 9	4 3/4	0 3	0	1 11	0 3	0 15	1 9	1 9	0 1	0 1	4
		4 0	4 1/2	0 1	0	0 12	0 13	1 4	0 7	1 12	0 3	0 1	3
		4 3	3 3/4	0 7	0	1 8	0 12	0 14	0 8	1 13	0 1	0 2	8
		Average	4.5	0 3.8	0 0.4	1 12.8	0 7.2	1 0.8	0 12.0	1 7.2	0 1.8	0 2.2	5.0

TABLE 2 - (Continued)

AVERAGE WEEKLY FOOD CONSUMPTION OF SUBJECTS

Case	Sex	Age	Kinds and quantities of food consumed per week: Milk	Potatoes, sweet & white	Dry beans peas, & nuts	Citrus fruits, tomatoes	Green & yellow vegetables	Other vegetables & fruits	All meats	Cereal products	Fats	Sugar products	Eggs
		yr. mo.	qt.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	no
VI	M	3 4	4 1/2	0 3	0	1 1	0 2	1 14	0 13	1 15	0 2	0 1	4
		3 7	5	0 7	0	3 1	0 3	1 14	0 14	2 1	0 3	0	2
		3 10	5 1/4	0 5	0	1 15	0 5	1 4	0 8	2 8	0 2	0	1
		4 1	6 1/4	0 9	0 4	0 11	0 11	2 0	1 4	1 4	0 2	0	4
		4 4	5 1/4	0 6	0 1	2 2	0 7	0 12	1 3	1 10	0 1	0	2
		Average	5.2	0 6.0	0 1.0	1 12.4	0 5.6	1 8.6	0 14.8	1 14.0	0 2.0	0 0.2	2.6
VII	M	3 6	5 1/4	0 9	0	1 9	0 9	1 2	0 11	1 7	0 1	0 9	1
		3 9	5	1 3	0 3	3 5	0 4	2 4	0 8	0 15	0 1	0 1	1/2
		4 0	5 3/4	0 10	0	1 9	0 6	3 12	0 8	1 1	0 2	0 3	3
		4 3	5 3/4	0 7	0	1 1	0 10	0 15	1 5	1 9	0 2	0 5	3
		4 6	5	0 8	0 1	1 3	0 9	1 15	0 9	1 6	0 2	0 15	2
		Average	5.3	0 10.6	0 0.8	1 11.8	0 7.6	2 0.0	0 11.4	1 4.4	0 1.6	0 6.6	1.9
VIII*	M	3 3	7/8	1 7	0 1	3 3	0 10	3 9	0 3	2 5	0 3	0 4	8
		3 6	1/16	1 10	0	3 2	0 11	2 4	1 15	3 10	0	0 1	8
		3 9	3/4	1 0	0	4 1	0 8	2 4	1 9	2 12	0 1	0 4	14
		Average	0.6	1 5.7	0 0.3	3 7.3	0 9.7	2 14.3	1 3.7	2 14.3	0 1.3	0 3.0	10
Average for all subjects			5.1	0 8.0	0 0.4	2 3.0	0 7.2	1 10.2	0 13.0	1 13.3	0 1.6	0 2.7	4.2
Standard**			5	0 8	– –	1 12	2 0	2 0	0 8	1 4	0 4	0 2	6

*Allergic to milk.

**Standard given in Family Food Plans, U.S. Dept. Agric. AWI-78, 1943.

given in the form of concentrates. Case VIII required calcium wafers because of his allergy to milk but the other cases were given pharmaceutics often for no particular reason. Furthermore, these concentrated nutrients were given at no particular month nor consistently throughout the year.

2. The average daily nutrient intake of the subjects for the entire experimental year was adequate except for slight deficiencies of calcium for Cases III and V and of iron for Cases I and V.

3. The nutrient intake for an individual subject was rather uniform from one experimental week to another throughout the year. Marked fluctuations were caused by the intake of pharmaceutics. Small deficiencies of a nutrient for only one experimental week are not significant as in calcium for Case IV.

B. Consumption of food groups

The data on the weekly food consumption of the subjects presented in Table 2 show that:

1. These subjects consumed comparatively small amounts of food.

2. Milk and milk product consumption in no case met the liberal daily allowance of one quart per child, although the subjects, with the exception of Cases IV and VIII, met the standard. (Case VIII was allergic to milk.)

3. The consumption of potatoes fluctuates greatly for most cases and is below standard for 6 of the 8 subjects.

4. Citrus fruit and tomato consumption is adequate for each case, giving an average consumption for all subjects well above the standard.

5. The greatest deficiency in food intake exists for green and yellow vegetables, with no subject consuming even as much as 50 percent of the standard. The average consumption of the subjects as a group for green and yellow vegetables was as low as 23 percent.

6. Only 2 of the 8 subjects consumed adequate amounts of other vegetables and fruits. The deficiency for the group was not as drastic as that for green and yellow vegetables.

7. The consumption of all kinds of meat was adequate for all subjects and more than 100 percent above the standard for Cases III and VIII.

8. The total amount of cereal products consumed by the subjects was adequate in most cases.

9. The amount of fat consumption as recorded was somewhat low, but this is not significant as the record does not include fats used in cooking.

10. The consumption of sugar products as recorded was ade-

quate. However, the amount actually consumed was probably much greater, because the quantity recorded represents only the sugar and sugar products eaten as such and not those used in food preparation.

11. Only Case VIII consumed an adequate number of eggs, whereas 4 cases consumed 50 percent or less of the standard.

TABLE 3

AFFECTIVE CONCOMITANT DURING FOOD INTAKE
ANALYSIS ON THE BASIS OF PREFFRENCE
ALL FOODS COMBINED

Case	Total frequency	VP		P		VP / P		N		U		VU		V / VU	
		F*	%	F	%	F	%	F	%	F	%	F	%	F	%
I	552	175	31.70%	292	52.90%	467	84.60%	63	11.41%	20	3.62%	2	0.36%	22	3.99%
II	315 (525)**	229	72.70%	69	21.90%	298	94.60%	9	2.86%	6	1.90%	2	0.63%	8	2.54%
III	294 (490)	162	55.10%	91	30.95%	253	86.05%	31	10.54%	3	1.02%	7	2.38%	10	3.40%
IV	605	156	25.79%	205	33.88%	361	59.67%	171	28.26%	64	10.58%	9	1.49%	73	12.07%
V	455	107	23.52%	294	64.62%	401	88.13%	44	9.67%	7	1.54%	3	0.66%	10	2.20%
VI	507	220	43.39%	159	31.36%	379	74.75%	83	16.37%	32	6.31%	13	2.56%	45	8.88%
VII	534	156	29.21%	275	51.50%	431	80.71%	85	15.92%	13	2.43%	5	0.94%	18	3.37%
VIII	342 (570)	210	61.40%	95	27.78%	305	89.18%	24	7.02%	7	2.05%	6	1.75%	13	3.80%
Mean			42.85%		39.36%		82.21%		12.76%		3.68%		1.35%		5.03%
Median			37.55%		32.62		85.33%		10.98%		2.24		1.22%		3.60

*F. frequency

**Numbers within the parentheses have been computed to make the total frequencies of Cases II, III and VIII, who had only three weekly food records instead of five, comparable to those of the other cases.

II. Affective concomitant

A. Analysis on the basis of preference

1. Table 3 gives a comprehensive picture of the affective concomitant of each subject as well as of the group as a whole during the food intake. Several general trends are clearly in-

dicated:

a. With all the subjects pleasant affective responses (VP + P) predominate over neutral and unpleasant responses combined (N + U + VU).

b. With 50 percent of the subjects pleasant affective concomitant is more prevalent than very pleasant. With the remaining 50 percent the reverse is true.

c. The entire group gives more neutral responses than unpleasant and very unpleasant responses combined.

d. With one exception very unpleasant affective concomitant is less frequent than unpleasant affective concomitant in all the subjects.

It would seem from the above facts that food consumption was a pleasurable occupation to the subjects.

TABLE 4

AFFECTIVE CONCOMITANT DURING FOOD INTAKE
ANALYSIS ON THE BASIS OF PREFERENCE
MAJOR FOOD DIVISIONS

Major Food Divisions	Central Tendencies	VP	P	VP + P	N	U	VU	U + VU
		%	%	%	%	%	%	%
A Meats	Mean	60.00+	30.09+	90.09+	6.63-	2.07+	1.21	3.28+
	Median	67.12	25.42	96.46	2.19-	0	0	1.35
B Fish	Mean	62.50	37.50	100.00	0	0	0	0
	Median	75.00	25.00	100.00	0	0	0	0
C Fowl	Mean	75.00	21.43-	96.43-	3.57+	0	0	0
	Median	100.00	0	100.00	0	0	0	0
D Eggs	Mean	48.07+	34.72+	82.79+	8.22-	7.52	1.47	8.99+
	Median	30.20	33.03	89.15	7.28-	2.09-	0	2.09-
E Dairy products	Mean	46.08-	42.06-	88.13	10.94+	0.52-	0.41	0.93-
	Median	35.98-	39.55	92.02-	7.29	0	0	0.40
F Vegetables	Mean	27.30-	43.01-	70.30+	16.68-	9.51-	3.51+	13.02
	Median	22.93	44.26-	76.67-	15.96-	5.26	3.10	8.68-
G Fruits	Mean	46.66+	37.80+	84.47-	12.12+	2.71	0.70	3.41
	Median	47.98-	35.30	88.20-	11.03-	2.03	0	2.60
H Cereal products	Mean	41.89-	38.82+	80.71-	16.27	2.22+	0.80	3.02+
	Median	35.06-	35.42-	82.18-	15.64	1.62	1.02	2.01
I Food combinations	Mean	46.19-	37.15	83.34-	11.75-	2.68+	2.24-	4.92-
	Median	44.03-	34.69	82.61-	12.90-	1.67-	0	3.39
J Custards, puddings and gelatin desserts	Mean	50.22-	43.80-	94.01+	5.99-	0	0	0
	Median	52.78	36.93	98.39-	1.62-	0	0	0
K Concentrated sweets	Mean	70.78-	25.65	96.43-	3.57+	0	0	0
	Median	100.00	0	100.00	0	0	0	0
L Pharmaceutics	Mean	14.78-	69.32	84.09	6.82	9.09	0	9.09
	Median	14.78-	69.32	84.09	6.82	9.09	0	9.09
M Miscellaneous food items	Mean	56.59	41.90-	98.49-	0	1.52-	0	1.52-
	Median	50.00	50.00	100.00	0	0	0	0

2. Table 4 shows the affective concomitant of the subjects for each of the thirteen major food divisions. From the figures the following facts may be derived:

a. Fish was unanimously and exceedingly well liked. With the exception of one isolated response, concentrated sweets, and miscellaneous items (e.g., beverages, gravies, pickles, and sauces) were also very well liked.

b. Fowl, meats, dairy products, and custards, puddings, and gelatin desserts were well liked.

c. Eggs, fruits, food combinations (e.g., salads, sandwiches, and soups) and pharmaceutics (e.g., cod liver oil, vitamin tablets, and calcium wafers) were liked.

d. Cereal products were somewhat less enthusiastically received.

e. Vegetables were definitely the least preferred of all the major food divisions.

3. A more detailed examination of each of the units and sub-units composing the 13 major food divisions revealed a multitude of interesting facts of which only the most salient will be included.

a. Meats

(1) Pork and beef were the two kinds of meat most frequently included in the children's menus. All the subjects, except Case VII, preferred pork to beef, although both kinds of meat were well liked. (The rank scores for pork and beef for the entire experimental group are 1.38+ and 1.71+ respectively.)[6]

(2) In the case of pork, bacon and ham vied with each other for popularity. The subjects were evenly divided in their preference for one or the other. On the whole, ham (rank score: 1.17+) was somewhat more popular than bacon (rank score: 1.35-). Fresh pork was definitely not as well liked as cured pork.

(3) With beef, major cuts (rank score: 1.60+) were preferred to sundry cuts (rank score: 2.03+) by all the subjects except Case V.

(4) Among major cuts the order of preference was: (1) steak (rank score: 1.19-), (2) meat loaf (rank score: 1.41+), (3) roast (rank score: 1.59-).

(5) In regard to the ways of preparing beef, that cooked with vegetables (rank score: 1.00) was preferred to that cooked by itself (rank score: 1.33+).

b. Fish

From the very limited data available it is very apparent that salmon (rank score: 1.00), trout (rank score: 1.00),

[6]*Unless otherwise stated, all the rank scores are for the entire experimental group.*

and halibut (rank score: 1.40), were all very popular, whether fresh or canned, whether fried, baked, or boiled. These were the only kinds of fish served sufficiently frequently to justify statistical treatment.

c. Fowl

The only kind of fowl served was chicken. Four methods of preparation were used. In the descending order of popularity they were (1) broiling (rank score: 1.00), (2) baking (rank score: 1.88-), (3) frying (rank score: 2.00), and (4) roasting (rank score: 3.00).

d. Eggs

The only kind used was chicken eggs. Among the various methods of preparation the commonest were deviling, scrambling, and soft-boiling. Soft-boiled eggs were the most popular (rank score: 1.64+); scrambled eggs ranked second (rank score: 1.77-); deviled eggs were the least preferred (rank score: 1.81+).

e. Dairy products

(1) Dairy products were divided into 3 subdivisions: (1) fluid milk, (2) frozen milk products, and (3) cheese. Of these, frozen milk products were the most popular (rank score: 1.11-); cheese ranked a close second (rank score: 1.20); fluid milk was the least preferred (rank score: 1.91-).

(2) Between flavored and unflavored fluid milk the former was unanimously preferred. (The rank scores are 1.77- and 2.02+ respectively.)

f. Vegetables

(1) With the exception of Case III, who showed a slight preference for green and yellow vegetables to other vegetables, all the subjects preferred other vegetables (rank score: 2.04-) to green and yellow vegetables (rank score: 2.44-). With Cases VII and VIII the preference was marked; with Cases IV and VI it was almost overwhelming; with Cases I, II, and V it was mild but present.

(2) The green and yellow vegetables were subdivided into fruits, leaves, roots, seeds, and stems. Among them seeds (rank score: 2.18-) were most popular. Fruits (rank score: 2.21+) ranked second in the order of preference. Roots (rank score: 2.26-) and stems (rank score: 2.38+) occupied the third and fourth places respectively. Leaves (rank score: 2.81-) were the least preferred of all. Individual differences in the order and degree of preference for these five groups of green and yellow vegetables were very marked.

(3) The other vegetables were subdivided into fruits, roots, seeds, stems, and stem tubers. Among them fruits and stem tubers shared the first place in popularity (rank score

for both: 1.97-). Roots (rank score: 2.09-) and seeds (rank score: 2.20) ranked third and fourth respectively in the order of preference. Stems (rank score: 2.62-) were the least liked of all. Individual differences in the order and degree of preference for these five varieties of other vegetables were very marked.

(4) There were 5 methods commonly used in the preparation of white potatoes. Among them baking (rank score: 1.66-) was the most popular, with ricing (rank score: 1.69-) a close second. Boiling (rank score: 1.77-) ranked third, while mashing (rank score: 2.10-) and creaming (rank score: 2.26+) occupied the fourth and fifth places respectively. As a group the subjects liked white potatoes, although marked individual differences in the order and degree of preference for these five methods of preparation were present.

(5) Raw tomatoes, tomato juice, and broiled fresh tomatoes were the 3 types of tomato dishes most frequently served to the subjects. Of these, raw tomatoes were the most popular (rank score: 1.79+). Tomato juice ranked a close second (rank score: 1.96+). Broiled fresh tomatoes were not so well liked (rank score: 2.27+).

g. Fruits

(1) Cases I, II, III, and VII preferred citrus to non-citrus fruits. Cases IV, V, VI, and VIII showed their preference in the opposite direction. The group as a whole liked non-citrus fruits (rank score: 1.68-) somewhat better than citrus fruits (rank score: 1.84+).

(2) Grapefruit and oranges were the only citrus fruits served. All the subjects preferred oranges (rank score: 1.77-) to grapefruit (rank score: 2.22+).

(3) Of the non-citrus fruits included in the subjects' menus, the most frequently used, listed in the descending order of preference, were: (1) grapes, including raisins (rank score: 1.32-), (2) bananas (rank score: 1.47-), (3) peaches (rank score: 1.49+), (4) apples (rank score: 1.63-), (5) pineapples (rank score: 1.78-), (6) apricots (rank score: 1.92-), and (7) plums, including prunes, (rank score: 2.37-).

h. Cereal products

(1) With the exception of Case III, all the subjects preferred refined (rank score: 1.68-) to whole-grain cereal products (rank score: 2.12+).

(2) Of refined cereal products the 4 categories most frequently included in the subjects' menus, arranged in the descending order of popularity, were: (1) cakes (rank score: 1.26+), (2) cookies (rank score: 1.35-), (3) cereals (rank score: 1.73+), and (4) breads (rank score: 1.85-).

(3) Of refined breads, quick breads were the most popular (rank score: 1.63-); crackers ranked second (rank score: 1.79-); yeast breads were the least preferred of all (rank score: 1.86-). Considering the closeness of these rank scores, it is apparent that there was little difference in popularity among the three types of refined breads.

(4) Of refined cereals the group showed a slight preference for ready-to-eat (rank score: 1.55-) to cooked cereals (rank score: 1.61+).

(5) Whole-grain cereal products were divided into 3 categories: (1) breads, (2) cereals, and (3) cookies. Only one subject, Case I, was served cookies, and she preferred them to both breads and cereals. In regard to the last two varieties of whole-grain cereal products Cases IV, VI, VII, and VIII preferred breads to cereals, while Cases I, II, III, and V preferred cereals to breads. These preferences were mild but nevertheless consistent. To the group as a whole, breads (rank score: 2.05+) were more acceptable than cereals (rank score: 2.31+).

(6) Whole-grain breads were composed of 3 subgroups: (1) crackers, (2) quick breads, and (3) yeast breads. Of these, quick breads (rank score: 1.10) were decidedly most popular; yeast breads (rank score: 2.17-) ranked second; crackers (rank score: 2.68) were least liked.

(7) Of whole-grain cereals the subjects preferred ready-to-eat (rank score: 2.05+) to cooked (rank score: 2.52-) varieties.

i. Food combinations

Four groups of food constituted this ninth major food division. In the descending order of preference they were: (1) sandwiches (rank score: 1.53-), (2) soups (rank score: 1.65-), (3) other food combinations such as stews, casseroles, croquettes, hash, succotash, and soufflés (rank score: 1.91-), and (4) salads (rank score: 1.95).

j. Custards, puddings, and gelatin desserts

Of the 3 food groups composing this tenth major food division, puddings were the most popular (rank score: 1.53-). Gelatin desserts ranked second (rank score: 1.61-). Custards were a very close third (rank score: 1.64-). All these three groups of food were pleasantly received.

k. Concentrated sweets

Concentrated sweets were of two subdivisions; namely, candies and other sweets such as jams, jellies, preserves, and honey. The former (rank score: 1.26+) was preferred to the latter (rank score: 1.50).

l. Pharmaceutics

Of the 8 children participating in the present study,

Case I alone consumed a sufficient amount and variety of pharmaceutics in undisguised forms to warrant statistical treatment of her results. Consequently, the data for this food division will not be discussed in detail in this report.

m. Miscellaneous

Beverages, gravies, sauces, and pickles were the 4 subdivisions composing the last major food division. In the order of decreasing popularity they were: (1) pickles (rank score: 1.00), (2) sauces (rank score: 1.17-), (3) beverages (rank score: 1.50), and (4) gravies (rank score: 2.00).

B. Analysis on the basis of learning[7]

1. Comparison of affective concomitant during the 5 experimental weeks

Table 5 presents the affective concomitant of the experimental group during the food intake in each of the 5 experimental weeks. It gives both the percentage of frequency for each type of affective concomitant and the rank score for the affective reaction of the group for the period. By comparing the corresponding figures in these five successive and uniformly spaced experimental weeks, one is able to derive an accurate picture of

TABLE 5

AFFECTIVE CONCOMITANT DURING FOOD INTAKE
ANALYSIS ON THE BASIS OF LEARNING
COMPARISON OF AFFECTIVE CONCOMITANT DURING FIVE EXPERIMENTAL WEEKS

Experimental week	Total frequency	VP		P		N		U		VU		Rank score
		F	%	F	%	F	%	F	%	F	%	
I	857 (551)*	423 (223)	49.36- (40.47%)	314 (239)	36.64- (43.38-)	65 (46)	7.58% (8.35-)	42 (36)	4.90% (6.53%)	13 (7)	1.52- (1.27%)	1.73- (1.85-)
II	895 (580)	360 (178)	40.22% (30.69-)	370 (283)	41.34% (48.79%)	112 (81)	12.51% (13.97-)	35 (27)	3.91% (4.66-)	18 (11)	2.01% (1.90-)	1.86% (1.98%)
III	839 (509)	377 (158)	44.93% (31.04%)	311 (218)	37.07- (42.83-)	118 (104)	14.06% (20.43%)	21 (19)	2.50% (3.73%)	12 (10)	1.43% (1.96%)	1.78% (2.03-)
IV	484	115	23.76%	235	48.55%	100	20.66%	31	6.40%	3	0.62-	2.1[illegible]-
V	529	140	26.47-	250	47.26-	115	21.74-	23	4.35-	1	0.19-	2.05-

*Numbers within the parenthesis represent the quantitive data of the experimental group from which Cases II, III and VIII, who had only three weekly food records instead of five, have been excluded.

[7] *All the quantitative results presented in this part of the study have been computed both with and without the inclusion of the data from Cases II, III, and VIII, who had only three weekly food records instead of five.*

the general trends of change in affective concomitant during the food intake in the course of one year. Whether these changes were due primarily to development or to learning is beyond the scope of the study. The major task of the present writer is to describe those changes precisely and to interpret them in the light of the total behavior patterns of the subjects.

Table 5 reveals two general trends of change:

a. The rank scores reveal a tendency for the affective concomitant to become somewhat less pleasant with age. However, the change is mild.

b. The percentages of frequency show both very pleasant and very unpleasant affective concomitant to decrease, and pleasant and neutral affective concomitant to increase, with age. Unpleasant affective concomitant, however, assumes a fickle characteristic.

c. These same general trends remain unchanged when the data from Cases II, III, and VIII are excluded from the combined results.

From the above data it would seem that intense types of affective concomitant give way to more moderate types as food consumption becomes a more and more established habit with the rapidly developing preschool child.

An examination of the data of each of the subjects whose combined results compose the figures presented in Table 5 showed that within the general group trends pointed out above, individual differences are marked both in the amount and the evenness of the changes from one experimental week to another.

A more detailed analysis of the same data under each of the 13 major food divisions revealed the same general trends of change throughout the 5 experimental weeks in every division except that of pharmaceutics of which the data came almost exclusively from one subject. Here, again, marked individual deviations are found within the general group trends.

2. Types of learning[8]

By analyzing the affective concomitant of each subject during the consumption of any dish which had appeared more than

[8] *In the strict sense of the term "learning," Types 3, 4, and 5 are not learning from the standpoint of changes in affective concomitant. However, if one remembers that VP, P, N, U, and VU are relatively coarse measures of affective concomitant at best, and that in establishing criteria for determining the presence of the learning process, the total behavior pattern of the child, rather than his affective responses alone, is taken into consideration, one would probably agree with the present writer that, in a broader sense, Types 3, 4, and 5 should be regarded as learning types in food consumption.*

once in the subject's weekly menus, it was possible to piece together successions of affective responses which revealed various types of learning that the subject had adopted in response to different dishes during the entire experimental period. By means of this technique 7 types of learning have been discovered. They are: (1) positive learning, (2) negative learning, (3) pleasant affective concomitant remaining constant, (4) neutral or unpleasant affective concomitant remaining constant, (5) fickle affective concomitant, (6) negative learning succeeded by positive learning, (7) positive learning succeeded by negative learning.

TABLE 6

AFFECTIVE CONCOMITANT DURING FOOD INTAKE
ANALYSIS ON THE BASIS OF TYPES OF LEARNING
ALL FOODS COMBINED

Case	Total frequency	Frequency, percentage of frequency, and rank order	Types of learning						
			1	2	3	4	5	6	7
I	77	Frequency	16	12	26	3	5	10	5
		Percentage	20.78-	15.58%	33.77-	3.90-	6.49%	12.99-	6.49%
		Rank order	2	3	1	7	5½	4	5½
II	53	Frequency	7	5	33	0	4	3	1
		Percentage	13.21-	9.43%	62.26%	0	7.55-	5.66%	1.89-
		Rank order	2	3	1	7	4	5	6
III	49	Frequency	12	4	19	0	4	7	3
		Percentage	24.49-	8.16%	38.78-	0	8.16%	14.29-	6.12%
		Rank order	2	4½	1	7	4½	3	6
IV	90	Frequency	13	24	29	4	9	2	9
		Percentage	14.44%	26.67-	32.22%	4.44%	10.00	2.22%	10.00
		Rank order	3	2	1	6	4½	7	4½
V	74	Frequency	10	17	28	1	4	7	7
		Percentage	13.51%	22.97%	37.84-	1.35%	5.41-	9.46-	9.46-
		Rank order	3	2	1	7	6	4½	4½
VI	71	Frequency	8	13	25	5	6	8	6
		Percentage	11.27-	18.31-	35.21%	7.04%	8.45%	11.27-	8.45%
		Rank order	3½	2	1	7	5½	3½	5½
VII	69	Frequency	10	26	18	2	5	6	2
		Percentage	14.49%	37.68%	26.09-	2.90-	7.25-	8.70-	2.90-
		Rank order	3	1	2	6½	5	4	6½
VIII	59	Frequency	10	9	29	3	3	3	2
		Percentage	16.95-	15.25%	49.15%	5.08%	5.08%	5.08%	3.39-
		Rank order	2	3	1	5	5	5	7
All eight subjects	542	Frequency	86	110	207	18	40	46	35
		Percentage	15.87-	20.30-	38.19%	3.32%	7.38%	8.49-	6.46-
		Rank order	3	2	1	7	5	4	6
Cases I, IV, V, VI, & VII only	381	Frequency	57	92	126	15	29	33	29
		Percentage	14.96%	24.15-	33.07%	3.94-	7.61%	8.66%	7.61%
		Rank order	3	2	1	7	5½	4	5½

TABLE 7

AFFECTIVE CONCOMITANT DURING FOOD INTAKE
ANALYSIS ON THE BASIS OF TYPES OF LEARNING
MAJOR FOOD DIVISIONS

Foods	Total frequency	Frequency, percentage of frequency, and rank order	Types of learning						
			1	2	3	4	5	6	7
A Meats	36 (24)*	Frequency	8 (4)	10 (8)	10 (6)	0 (0)	5 (4)	3 (2)	0 (0)
		Percentage	22.22% (16.67-)	27.78- (33.33%)	27.78- (25.00)	0 (0)	13.89- (16.67-)	8.33% (8.33%)	0 (0)
		Rank order	2 (3½)	1½ (1)	1½ (2)	6½ (6½)	4 (3½)	5 (5)	6½ (6½)
B Fish	2 (1)	Frequency	0 (0)	0 (0)	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)
		Percentage	0 (0)	0 (0)	100.00 (100.00)	0 (0)	0 (0)	0 (0)	0 (0)
		Rank order	4½ (4½)	4½ (4½)	1 (1)	4½ (4½)	4½ (4½)	4½ (4½)	4½ (4½)
C Fowl	10 (7)	Frequency	0 (0)	1 (1)	8 (5)	1 (1)	0 (0)	0 (0)	0 (0)
		Percentage	0 (0)	10.00 (14.29-)	80.00 (71.43-)	10.00 (14.29-)	0 (0)	0 (0)	0 (0)
		Rank order	5½ (5½)	2½ (2½)	1 (1)	2½ (2½)	5½ (5½)	5½ (5½)	5½ (5½)
D Eggs	24 (15)	Frequency	7 (5)	4 (4)	8 (3)	0 (0)	1 (1)	3 (1)	1 (1)
		Percentage	29.17- (33.33%)	16.67- (26.67-)	33.33% (20.00)	0 (0)	4.17- (6.67-)	12.50 (6.67-)	4.17- (6.67-)
		Rank order	2 (1)	3 (2)	1 (3)	7 (7)	5½ (5)	4 (5)	5½ (5)
E Dairy products	24 (17)	Frequency	3 (2)	5 (4)	15 (10)	0 (0)	0 (0)	1 (1)	0 (0)
		Percentage	12.50 (11.76%)	20.83% (23.53-)	62.50 (58.82%)	0 (0)	0 (0)	4.17- (5.88%)	0 (0)
		Rank order	3 (3)	2 (2)	1 (1)	6 (6)	6 (6)	4 (4)	6 (6)
F Vegetables	159 (114)	Frequency	32 (21)	35 (29)	33 (20)	10 (8)	12 (8)	20 (14)	17 (14)
		Percentage	20.13- (18.42%)	22.01% (25.44-)	20.75% (17.54%)	6.29- (7.02-)	7.55- (7.02-)	12.58- (12.28%)	10.69% (12.28%)
		Rank order	3 (2)	1 (1)	2 (3)	7 (6½)	6 (6½)	4 (4½)	5 (4½)
G Fruits	78 (52)	Frequency	9 (7)	20 (15)	29 (14)	1 (1)	6 (4)	7 (6)	6 (5)
		Percentage	11.54- (13.46%)	25.64% (28.85-)	37.18- (26.92%)	1.28% (1.92%)	7.69% (7.69%)	8.97% (11.54-)	7.69% (9.62-)
		Rank order	3 (3)	2 (1)	1 (2)	7 (7)	5½ (6)	4 (4)	5½ (5)

*Numbers within the parentheses represent the quantitative data of the experimental group from which cases II, III and VIII, who had only three weekly food records instead of five, have been excluded.

TABLE 7 - (Continued)

AFFECTIVE CONCOMITANT DURING FOOD INTAKE
ANALYSIS ON THE BASIS OF TYPES OF LEARNING
MAJOR FOOD DIVISIONS

Foods	Total frequency	Frequency, percentage of frequency, and rank order	Types of learning						
			1	2	3	4	5	6	7
H Cereal Products	145 (101)	Frequency	15 (10)	24 (21)	67 (40)	6 (5)	15 (11)	10 (8)	8 (6)
		Percentage	10.34% (9.90%)	16.55% (20.79%)	46.21% (39.60%)	4.14% (4.95%)	10.34% (10.89%)	6.90% (7.92%)	5.52% (5.94%)
		Rank order	3½ (4)	2 (2)	1 (1)	7 (7)	3½ (3)	5 (5)	6 (6)
I Food combinations	25 (16)	Frequency	6 (3)	7 (6)	10 (5)	0 (0)	1 (1)	0 (0)	1 (1)
		Percentage	24.00 (18.75)	28.00 (37.50)	40.00 (31.25)	0 (0)	4.00 (6.25)	0 (0)	4.00 (6.25)
		Rank order	3 (3)	2 (1)	1 (2)	6½ (6½)	4½ (4½)	6½ (6½)	4½ (4½)
J Custards, puddings and gelatin desserts	16 (12)	Frequency	2 (1)	1 (1)	11 (9)	0 (0)	0 (0)	1 (0)	1 (1)
		Percentage	12.50 (8.33%)	6.25 (8.33%)	68.75 (75.00)	0 (0)	0 (0)	6.25 (0)	6.25 (8.33%)
		Rank order	2 (3)	4 (3)	1 (1)	6½ (5)	6½ (6)	4 (6)	4 (3)
K Concetrated sweets	10 (10)	Frequency	0 (0)	0 (0)	9 (9)	0 (0)	0 (0)	1 (1)	0 (0)
		Percentage	0 (0)	0 (0)	90.00 (90.00)	0 (0)	0 (0)	10.00 (10.00)	0 (0)
		Rank order	5 (5)	5 (5)	1 (1)	5 (5)	5 (5)	2 (2)	5 (5)
L Pharmaceutics	4 (4)	Frequency	1 (1)	1 (1)	2 (2)	0 (0)	0 (0)	0 (0)	0 (0)
		Percentage	25.00 (25.00)	25.00 (25.00)	50.00 (50.00)	0 (0)	0 (0)	0 (0)	0 (0)
		Rank order	2½ (2½)	2½ (2½)	1 (1)	5½ (5½)	5½ (5½)	5½ (5½)	5½ (5½)
M Miscellaneous	9 (8)	Frequency	3 (3)	2 (2)	3 (2)	0 (0)	0 (0)	0 (0)	1 (1)
		Percentage	33.33% (37.50)	22.22% (25.00)	33.33% (25.00)	0 (0)	0 (0)	0 (0)	11.11% (12.50)
		Rank order	1½ (1)	3 (2½)	1½ (2½)	6 (6)	6 (6)	6 (6)	4 (4)

a. Table 6 presents in quantitative terms the result of the analysis of affective concomitant data on the basis of these 7 types of learning. All the foods consumed are treated here as one combined unit. The following are the outstanding facts shown in this table:

(1) When the experimental group was taken as a whole, Type 3 was the commonest type of learning. The other 6 learning types, arranged in the descending order of frequency, are: (2) Type 2, (3) Type 1, (4) Type 6, (5) Type 5, (6) Type 7, and (7) Type 4.

(2) Excluding Cases II, III, and VIII, because of their incomplete data, does not alter the order of frequency of the 7 learning types, although the exact percentages of frequency are somewhat changed. In general, the exclusion seems to cause a slight decrease in the percentages of frequency of positive types of learning (i.e., 1 and 3), and a slight increase in the percentages of frequency of negative types of learning (i.e., 2 and 4).

(3) When all the 8 subjects were considered individually in regard to the 7 types of learning, it was found that Type 3 was the most predominant type of learning with all the children except Case VII whose prevailing type of learning was Type 2.

(4) Type 4 was the least common type of learning with 6 of the 8 subjects. With the two remaining subjects Type 4 was one of the less common types of learning.

(5) As regards Type 1, the subjects were evenly divided. With half of the children it was the third most frequent; with the other half it was second in the descending order of frequency.

(6) Individual differences were very pronounced with regard to the order of frequency of Types 2, 5, 6, and 7, especially 6.

b. Table 7 gives the result of a more detailed treatment of the same data presented in Table 6. These data have been analyzed under the 13 major food divisions. The following are the principal facts presented in this table:

(1) When all the 8 subjects were considered as a whole, Type 3 was the commonest type of learning in 10 of the 13 major food divisions. When Cases II, III, and VIII were excluded from the group, Type 3 was the commonest type of learning in 7 of the 13 major food divisions.

(2) Type 2 was the commonest type of learning with the eight-subject group in the case of vegetables. When Cases II, III, and VIII were excluded from the group, Type 2 was the prevailing learning type in meats, vegetables, fruits, and food

combinations.

(3) Whether the three cases were included in or excluded from the group, Type 1 remained among the most predominant types of learning in the case of eggs and miscellaneous food items.

(4) Type 4 was nonexistent in 9 of the 13 major food divisions and least frequent in the remaining 4. No major food division was disliked by the children as a group throughout the experimental period. This was true whether the group was composed of 8 subjects or 5.

(5) Type 7 was nonexistent in 6 of the 13 major food divisions, and least common or among the least common in 4.

(6) Type 5 was nonexistent in 7 of the 13 major food divisions and among the least frequent in 2.

Both (5) and (6) applied to the experimental group as a whole, whether the group consisted of 8 or 5 subjects.

(7) Type 6 was nonexistent in 5 major food divisions when the experimental group consisted of all the 8 subjects. (If Cases II, III, and VIII are excluded, the number is increased to 6.) It was the least common or among the least common in 4 major food divisions.

III. Physical status

Data on the heights and weights of the subjects are recorded in Table 8. The range for the group was from plus 20 percent to minus 13 percent with an average deviation from the average weight of plus 2 percent. All the weights of 4 of the 8 subjects were on or above the average for their height and age with only one weight, recorded for Case IV, more than 8 percent below the average. This subject gained weight during the following 3 months so that at the second weighing she was only 5 percent underweight.

The parts of the dental and pediatric examinations related to the nutritional status of the subjects are recorded in Table 9. No caries or discoloration of the teeth was reported. The soft tissue around the teeth of Case VI was found to be in only fair condition, whereas, that of each of the other subjects was good. Cases III and VI had poor occlusion. The indifferent piddling at the table by Case VI was ascribed to this condition. The interdental spaces were rated as fair or poor for the majority of the subjects at the various examinations. Out of the entire 21 ratings, 6 were poor, 10 fair, and only 5 good. Poor shape and size of the dental arch, therefore, appears to be the outstanding dental defect.

The general physical condition of all the subjects was con-

TABLE 8

HEIGHT, WEIGHT, AND DEVIATION FROM AVERAGE WEIGHT
FOR SUBJECTS RECORDED AT THREE-MONTH INTERVALS

Case	Sex	Age		Height		Weight		Average weight for height and age	Deviation from average weight
		yr.	mo.	in.	cm.	lb.	kg.	lb.	%
I	F	2	2	32.7	83.1	26.0	11.8	26	0
		2	5	33.2	84.3	30.0	13.6	26	+15
		2	8	34.4	87.4	30.2	13.7	26	+16
		2	11	34.6	87.9	31.6	14.3	29	+ 9
		3	2	35.8	90.8	32.2	14.6	30	+ 7
II	M	3	3	39.7	100.9	33.0	15.0	36	- 8
		3	6	40.5	102.9	33.5	15.2	36	- 7
		3	9	40.8	103.5	34.9	15.8	38	- 8
III	M	3	7	39.2	99.5	39.0	17.7	35	+11
		3	10	39.3	99.7	38.5	17.4	35	+10
		4	1	40.2	102.0	42.0	19.0	36	+ 7
IV	F	3	5	38.8	98.5	30.5	13.8	35	-13
		3	7	39.2	99.4	33.1	15.0	35	- 5
		3	10	39.8	101.0	34.6	15.7	36	- 4
		4	1	40.9	103.8	35.6	16.1	38	- 6
		4	5	41.8	106.1	37.4	16.9	39	- 4
V	F	3	3	36.7	93.2	33.0	15.0	32	+ 3
		3	6	37.0	94.0	33.7	15.3	32	+ 5
		3	8	37.7	95.8	36.4	16.5	33	+10
		3	11	38.6	97.9	36.9	16.7	35	+ 5
		4	3	39.3	99.8	38.3	17.3	35	+ 9
VI	M	3	4	39.3	99.8	33.0	15.0	35	- 6
		3	7	39.6	100.6	34.7	15.7	36	- 4
		3	10	40.2	102.1	36.0	16.3	36	0
		4	0	41.1	104.4	38.0	17.2	38	0
		4	4	41.8	106.2	37.6	17.0	39	- 4
VII	M	3	6	41.5	105.3	37.0	16.8	39	- 5
		3	9	41.6	105.7	38.9	17.6	39	0
		4	0	42.4	107.7	39.0	17.7	39	0
		4	2	43.2	109.7	40.4	18.3	41	- 1
		4	6	44.6	113.3	42.0	19.0	45	- 7
VIII	M	3	3	40.0	101.5	40.0	20.0	36	+11
		3	6	39.8	101.1	39.2	17.7	36	+ 9
		3	9	40.2	102.1	43.1	19.5	36	+20

*From table prepared by Robert M. Woodbury given in Rose, M.S. Feeding the Family, Macmillan, New York, 1940.

sidered good or excellent according to the evaluation by the pediatrician. The only abnormalities reported were those of slightly inflamed tonsils in 4 examinations and an anemic condition ranging from "quite severe" to "slight" in 10 examinations. Laboratory analyses showed a slightly anemic condition to be more or less prevalent, since of 21 examinations

TABLE 9

RESULTS OF BLOOD TESTS AND DENTAL EXAMINATIONS

Case	Sex	Age	Blood tests				Dental examinations	
			Hemoglobin	Erythrocytes	Leucocytes	Color index	Interdental spaces	Occlusion
		yr. mo.	%	no./cu. mm.	no./cu. mm			
I	F	2 3	72	3,850,000	7,650	0.90	good	good
		2 9	72	4,320,000	7,250*	0.83	fair-good	good
		3 7	84	4,380,000	11,350	0.90	fair	good
II	M	3 3	80	4,150,000	11,450*	0.90	poor	good
		3 9	86	4,300,000	7,400	1.00	fair	fair
III	M	3 8	55	3,940,000	4,200	0.70	good	poor
		4 2	78	4,280,000	6,600	0.90	good	poor
IV	F	3 5	70	4,270,000	7,900	0.89	fair-good	good
		3 11	80	4,330,000	9,250	0.90	poor	good
		4 8	80	4,270,000	9,150	0.90	fair-good	good
V	F	3 3	72	4,000,000	19,900	0.90	fair	good
		3 9	74	4,740,000	6,350	0.88	fair	good
		4 6	77	4,300,000	8,200	0.90	poor	good
VI	M	3 4	70	3,790,000	6,750	0.90	poor	poor
		3 10	72	3,830,000	4,850*	0.90	fair	poor
		4 7	74	3,860,000	7,850	0.90	fair	poor
VII	M	3 6	72	3,800,000	6,700	0.90	poor	good
		4 0	74	4,080,000	5,250	0.90	good	good
		4 10	75	4,200,000	9,000	0.90	good	good
VIII	M	3 4	70	3,090,000	6,100	0.89	poor	good
		3 9	80	4,480,000	8,200*	0.90	fair	fair-good

*Slight infection of tonsils reported by pediatrician.

15 showed hemoglobin levels to be below 78 percent, with one examination for Case III giving a result of 55 percent, and no examination giving results above 86 percent. The hemoglobin level of 86 percent was reached only by Case II who had been receiving iron concentrate. In the five-month interval between examinations the hemoglobin level of Case III was raised from 55 to 78 percent by incorporating iron rich foods in the diet as is shown by his iron intake in Table 1.

For the erythrocyte count, 7 examinations showed values below 4,000,000 erythrocytes, the lowest number being 3,090,000. The results indicate that a slight deficiency of the hemoglobin in the cells was prevalent among the subjects.

In the case of leucocyte count 5 examinations gave values above 9,000, the highest being 19,900. The high leucocyte counts coincided with tonsil infection in but one case. In all the other cases the high count is unexplained.

The results of these pediatric examinations neither indicate

drastic physical defects on the part of the subjects nor give a picture of buoyant health. Of the 8 subjects, Cases III and VI were the lowest in physical stamina, but the group as a whole might easily be considered healthy normal children.

Discussion

The subjects who received dietary supplements in the form of mineral and vitamin concentrates tremendously exceeded the dietary standard for those nutrients. Although the intake of massive doses of vitamins A and D and of iron are not harmful according to existing experimental findings, the doses probably are not effective in proportion to their quantity. No subject received a vitamin A-D preparation continuously throughout the year, although this practice is frequently recommended for children so young. The question arises as to the comparative affectiveness of massive doses of nutrients given sporadically and of moderate doses given in amounts commensurate with the recommended dietary standard regularly throughout the year. Dietary supplements, as these pharmaceutics are referred to, should be used to add to, but not to constitute the major portion of, a nutrient in a diet. The supplements given to these subjects were greatly out of proportion, in most instances, to the dietary needs of the individual.

The consumption of individual nutrients more nearly meets the recommended dietary standards than does that of the consumption of the food groups themselves. This may mean that the calculation of nutritive content of the foods has been too liberal, or that the dietary standard in terms of food groups is too generous. Certain probable errors occur, however, in many dietary studies because of variations in the nutrient composition of foods.

Calculation of nutritive value of foods from values given in tables on average compositions allows neither for deviations of a specific food produced in a given locality from the averages nor for possible losses of nutritive value during preparation. Average preparation losses are allowed for by the compositions given by Taylor (1), since most foods are listed as edible portion raw or cooked. Significant losses may occur from the most casual preparation processes such as peeling or coring an apple. Probable solution losses may occur where amounts of water used in cooking and the subsequent use of these "pot liquors" are not considered, as well as in the length of time a food is in water either soaking or cooking, the size and shape of pieces, whether peeled or unpeeled, and many other factors contributing to losses. Loss of vitamins by decomposition during cooking processes has been under investigation and the

detrimental effects of alkali, air, heat, and light are already established.

These many causes for the possible loss of nutrients from a fresh raw food produce deviations from average compositions given in tables, and are a disadvantage when calculating the nutritive value of a food rather than when determining the nutritive content by bioassay and chemical analysis. Complete chemical analysis, which at times must be checked by bioassay methods, is a long specialized process for which trained personnel and proper equipment are not always available. An experimenter is thus compelled to rely on calculations based on average compositions reported in the literature and compiled in tables in order to obtain an answer to the question of what the nutritive value of a diet is. In interpreting the data obtained by calculations, one realizes that the answer is probably only an average of a range of possible amounts of nutrients in a diet; therefore, one does not magnify the significance of small deviations from a dietary standard.

Standards for the amounts of foods which a person should consume in a given period of time are usually given in weights as purchased. Yet when one singles an individual out of a family and determines the amounts of food he consumes, one is forced to list mostly edible portions. For foods as milk, eggs, cereal products, and the like little difference exists between the quantity as purchased and the edible portion; but for fruits and vegetables there is a greater difference. One must keep this in mind when interpreting the adequacy of the amounts of fruits and vegetables consumed by these subjects. Differences in amounts between "as purchased" and "edible portion" would seldom be much more than 50 percent and for many fruits and vegetables they would be smaller.

Even when allowances were made for losses in the weight of the food during preparation, a drastic deficiency was found to exist for all subjects in the consumption of vegetables, especially green and yellow vegetables. The gravity of the situation is even more keenly appreciated when a careful examination of the affective concomitant records showed first, that the subjects liked vegetables least of all the 13 major food divisions; second, that negative learning was the most predominant type of learning in the case of vegetables; and third, that leaves were the most disliked of all the edible portions of green and yellow vegetables. In view of the fact that vegetables constitute one of the most important sources for a number of essential nutrients, coupled with the knowledge that the unfavorable reaction of the subjects toward vegetables probably mirrored the attitude of the general public, it would seem that mothers and nurses of

very young children should attempt at once to remedy this deplorable situation by the following methods. First, they might introduce more effective means of training their children to like vegetables when they are still infants. Second, they might render vegetable dishes more palatable by more diversified and improved methods of preparation. One of the incidental findings, reported earlier in this study, that beef cooked with vegetables was more acceptable to the subjects than that cooked by itself, may serve as a valuable lead to more interesting methods of preparing vegetables for young children.

Food consumption records further show that 7 of the 8 subjects ate an inadequate number of eggs. This deficiency was indeed unnecessary when both group and individual affective concomitant records indicate clearly that, with the possible exception of Cases IV and VI who disliked eggs prepared in certain ways, all the children liked eggs, and were, furthermore, learning to become more and more fond of them during the experimental year.

That 6 subjects did not consume sufficient amounts of potatoes was equally surprising when, as is evidenced by the affective concomitant records, they liked both sweet and white potatoes.

The rank score of 1.91 for fluid milk signifies that the affective concomitant for milk was definitely pleasant; therefore, the finding that no subject met the liberal allowance of one quart per day was without sound reason.

According to the affective concomitant records, non-citrus fruits, except prunes, were well liked. That 6 of the 8 subjects were reported in the food consumption data not to have consumed an adequate amount of non-citrus fruits, at least not enough to make up for the deficiency they had created in the consumption of the other fruit and vegetable group, was unwarranted.

Citrus fruits, on the contrary, were consumed in quantities well above the standard. This high consumption rate coincides with the findings of other dietary surveys made in this area; namely, those of Drake and Lamb (3) and Lamb and Corrington (4).

Affective concomitant records give consistent and conclusive evidence that children preferred refined to whole-grain cereal products, highly sweetened food items to unsweetened ones, and meats to vegetables. These findings should show those whose responsibility it is to train young children in sound dietary practices where to lay the proper emphasis in planning menus for their children. Since it is apparently the general tendency for young children to like refined cereal products because of the texture, highly sweetened foods because of the taste, and meats because of the flavor, should the training not be in the direction

of cheerful acceptance of whole-grain cereal products, unsweetened food items and vegetables as essential components of the dietary? Such can be done if the training is given early and judiciously.

It is interesting to note from affective concomitant data that, with both refined and whole-grain cereals, the subjects preferred ready-to-eat to cooked varieties. From the point of view of the amounts of nutrients per unit volume, cooked cereals far exceed ready-to-eat ones. Since it is the general practice of American housewives to measure the amount of food to be consumed by volume than by any other means, it will be a wise policy to encourage the children to eat cooked cereals at least as often as ready-to-eat varieties.

One of the most significant findings in the present study is the subjects' unanimous and strong fondness for fish. In consideration of the availability, digestibility, low cost, and high nutritive value of this major food division, it will be a sound policy that fish be included more frequently in the young child's diet.

By analyzing the affective concomitant data on the basis of learning, 7 different types of learning have been found. That Type 3 ("constant pleasant learning") was the most predominant of all types with the subjects in food consumption corroborates an earlier finding, based on the analysis of the affective concomitant data from the standpoint of preference, that eating was a pleasurable occupation to the children. From these results it would seem that by the time the young child reaches the nursery school age, he has already learned to enjoy a wide range of food, and his nursery school years are employed largely to consolidate his food preference.

Type 4 ("constant neutral or unpleasant learning"), on the contrary, was the least common type of learning with all the subjects in food consumption. This negative finding not only substantiates the positive discovery discussed in the preceding paragraph, but it likewise reveals a fortunate situation. For what would adults do, if by the time a child reaches the age of 2, 3, or 4, he has not yet learned to enjoy an occupation which he must confront at least three times a day?

Type 2 ("negative learning") was the predominant type of learning in the case of vegetables. Type 1 ("positive learning") was among the predominant types of learning in the case of eggs. Since we have already treated in some detail the significance of these two types of learning in vegetable and egg consumption respectively, we shall not discuss them further here.

Types 5 ("fickle learning"), 6 ("negative positive learning"), and 7 ("positive negative learning") were very uncommon types

of learning with all the subjects in food consumption. This is, in a way, fortunate, because all these three types of learning are more complex and, therefore, less predictable. For mothers and nurses who have to feed preschool children three or four times a day, their task is immeasurably lightened when the food likes and dislikes of these young people can be easily detected and predicted.

Even though these children were of normal health, some physical deficiencies were present in the group. Among these deficiencies was an anemic condition ranging from slight to severe. This condition in the subject paralleled a low iron intake. Imperfect dental development, resulting in poor occlusion and improper tooth arrangement, was also frequently recorded. That this is the result of improper diet during pre- and postnatal stages of development has been shown by Price (5). These are further evidences that the early diet of these subjects was not markedly deficient and yet not optimum.

Several subjects did not consume the recommended number of calories. Since their gains in weight for their height and age were normal from one experimental week to another, their calorie intake must have been adequate for their energy expenditure.

When these three sets of data, food consumption, affective concomitant, and physical status, were viewed as an interrelated whole, one sees the 8 children, participating in the present study, as typical of the community which they represented. From the layman's standpoint, they were normal in health, cheerful in disposition, and well-fed. However, when their food habits were carefully studied and physical conditions periodically checked, there is still much that can be done to improve their dietary practice in order to bring their physical well-being to an optimum.

SUMMARY AND CONCLUSIONS

This study investigates the food consumption and preferences of the preschool child. Eight children from the Nursery School of Texas Technological College, ranging in age from 2 years, 2 months to 3 years, 7 months, served as subjects. The study lasted one year during which food consumption and food preference records were taken simultaneously for one week at three-month intervals. Heights and weights were recorded at the beginning of each of these experimental weeks. Pediatric and dental examinations were given at the beginning, in the middle, and at the conclusion of the experimental period. These physical status records were taken to serve as a guide in the

determination of the nutritional status of the subjects.

From the results of this study, which consisted of both quantitative and qualitative data, the following general conclusions have been drawn:

1. By comparing the food consumption records gathered in this study with established standards it has been found that although the nutrient intake of a child may be generally adequate, his consumption of certain food groups can still fall short of the recommended amounts.

2. The preschool child has learned to like a wide variety of foods by the time he reaches the nursery school age and to regard eating as a pleasurable occupation.

3. As the preschool child grows older, intensely pleasant and unpleasant types of affective concomitant during food intake give way to more moderate types, and food consumption becomes a more matter-of-fact affair.

4. Preschool children of this locality have a tendency to like green and yellow vegetables least of all major food divisions, and to increase this lack of interest with age.

5. At least 7 types of learning have been found in the food consumption of the preschool child with positive types predominant.

6. Frequently inadequacy in the amounts and kinds of food consumed can be traced to faulty meal planning on the part of the responsible adult rather than to a lack of positive liking of the child for these foods.

7. When food consumption, food preference, and physical status records of the so-called normal and healthy children are simultaneously taken and analyzed, it becomes apparent that there is still much that can be done by way of improving their dietary practices in order to insure their optimum health and development.

REFERENCES

(1) Taylor, C. M. Food values in shares and weights. New York, Macmillan, 1942.

(2) Rose, M. S. Feeding the family. 4th ed., p. 406 and 407. New York, Macmillan, 1940.

(3) Drake, P., and Lamb, M. W. Study of the dietary and food practices of 63 families in Lubbock, Texas. J. Am. Dietet. Assoc., 1944, 20, 528-529.

(4) Lamb, M. W., and Corrington, M. T. A further analysis of food selections of 80 families in Lubbock, Texas. J. Am. Dietet. Assoc., 1946, 22, 134-138.

(5) Price, W. A. Nutrition and physical degeneration. New York, Harper, 1942.

EFFECT OF FATHER SEPARATION ON PRESCHOOL CHILDREN'S DOLL PLAY AGGRESSION[1]

ROBERT R. SEARS, MARGARET H. PINTLER, and PAULINE S. SEARS
Iowa Child Welfare Research Station
State University of Iowa

The factors that influence anger and aggression in young children are but imperfectly understood. While frustration may be assumed to be an antecedent condition (3), the variety of direction and form is so great that a number of other variables besides the frustration itself must be taken into account if specific instances of aggression are to become interpretable. This is particularly evident in the fantasied aggressions of projective doll play. As early as the third year, children show marked individual differences in both kind and amount (1), and by the fourth year sharp divergence between the sexes can be observed (8). These variations represent fairly consistent characteristics of individual children (4), but the life history experiences that create them have not been charted.

From a systematic standpoint, fantasied aggression may be considered as part of a hierarchy of aggressive actions arising from either temporary or chronic frustrations. What specific actions form this hierarchy depend on a number of things - the severity of the frustration, the availability of the frustrating agent, the inhibitions created by social controls, the repertory of motives or action systems with which the child is equipped, the amounts and kinds of rewards or punishments anticipated for each kind of potential reaction to the frustration, and so on. In general it has been assumed (3, pp. 44-46) that fantasied aggression is most likely to occur spontaneously when the various controlling factors are decisively weighted against a direct overt aggressive act. In other words, fantasy is relatively low in the hierarchy, and only when more direct methods are inhibited is it chosen.

In the doll play situation these same principles are operative, even though the fantasy is not spontaneous in the same sense. The play materials are designed to provide positive instigation toward fantasy action; it is not necessary to rely only on the elimination of all other competing action systems. The doll family and home serve to instigate "home actions," and the procedure on the part of the experimenter is designed to reduce

[1] *Reported in brief by the senior author at the Meeting of the Society for Research in Child Development at St. Louis, March 29, 1946.*

social inhibition of the related aggression. Consequently, this is expressed with a greater freedom than it would be if no such materials were available.

This interpretation of fantasy still leaves unexamined the relationship between the content of "real-life" and fantasied aggressive acts. From a clinical standpoint, it would be diagnostically useful to know the extent to which, and under what conditions, the two are similar. Levy (5) and others have hypothesized that, because the doll environment more or less duplicates the real home environment, there is instigation to fantasied acts having the same content, at least as to agent and object, as real-life acts. The kinds of aggression differ radically in the two types of act; Robinson (9) has shown that the great majority of fantasied aggressions are of a sort that by no stretch of imagination could be expected in the real-life interactions of a normal family. It may well be that kind is simply an expression of intensity, that children have a hierarchy of symbols which are no more than step intervals on a continuum from weak to strong aggression. For example, having the child doll say "no" to the mother doll might be a weak aggressive act (for one particular child), while his frying the mother doll on the stove or stuffing her down the toilet might be a stronger one. This whole set of problems, involving response-response (10) relationships, needs exploration.

A different kind of problem, but one that also arises from the systematic interpretation of fantasy, is that of stimulus-response relationships. If the child's hierarchy of aggressive acts contains fantasy aggression, the question must be raised as to what factors in the instigating situation determine the specific kinds and amounts.

Studies by Bach (1) and Yarrow (11) have examined the effects of prior frustrations, and Bach (2) has more recently studied the effect on school-age children's fantasies of the absence of the father from the home and the variations in kind of father-typing provided by the mother during his absence. In this latter study it was shown that the role the father played in the home, and the mother's attitudes toward him, were significant variables in determining the kinds of fantasied actions by the child in the post-departure period. For example, children whose mothers were antagonistic toward or contemptuous of the fathers showed more aggression toward the father doll than did children whose mothers were affectionate toward and were longing for the absent father.

The present study has employed this same family situation - father absence - with preschool age children, in order to secure further information on the role of the father in the fantasied

aggression of his child. In order to evaluate this situation as an instigator, some consideration must be given to the kinds of socially oriented motivational systems in the activation of which the father is important.

Among the most important of these is sex-typing. From birth the child is allocated to one sex or the other, and society begins to implant in him the motives, interests, skills, and attitudes appropriate to such membership. The learning process by which he develops these action systems depends, among other things, on the existence of models upon whose behavior he may pattern his own. For a boy child, the father is often the chief model. Further, there must be someone available who has a sound knowledge (not necessarily verbalized) of what constitutes the right and wrong sex-typed behavior. This is essential in order that a continuous rewarding and punishing of such actions may reinforce or extinguish them.

Since society is composed of two main sexes, children must also learn how to behave toward each. The girl must have opportunity to react to, to be motivated by, and develop skills of social interaction with adult males. She must not only become a "girl" herself, but must learn what men are like and how to live with them. The same may be said for the boy; he must become not only a "boy" but a proficient understander of and interactor with men. For this kind of learning, involving discriminations and cues that are largely unverbalized, only actual practice opportunities are of value.

It would be an over-simplification to suppose that the father's only function was to serve as a model for or interactor with his children. He is an integral part of a social complex involving his wife as well. Each member of the family acts as an instigator to special forms of behavior in the others. He is also the effective agent for rewards and punishments, and the human "tool" used for securing many satisfactions based on secondary motives of a social character. To withdraw any member of this group is to frustrate all such dependent action systems. Subtle but important emotional dependencies are destroyed; accustomed responses disappear; cooperative arrangements for child-rearing, sexual satisfactions, intellectual interstimulation, and maintenance of social status in the family's relations with other families are all interrupted.

One could catalogue almost ad infinitum the modifications in the total pattern of instigation acting on the child which occur when the father (or mother) leaves the home. In every instance there must necessarily be some frustration, and in many there are alleviations of unsatisfactory relationships. No algebraic summing of these advantages and disadvantages can represent the effect on the family members, for each person's behavior

is composed of multiple action systems and the ultimate consequences of interruption or facilitation are to some degree specific to each system.

The absence of the father from the home is a simple event only from the sociological standpoint. Strictly speaking, the instigation created by it is unique for each family and for each member of the family. However, the similarities of family life in a given culture may provide for some similarity in the effects of the event. The role of the father in the sex-typing aspect of child-training, for instance, may prove to be fairly uniform. He is nearly always a model and his masculine characteristics ordinarily seem to include greater aggressiveness and greater tolerance for the social expression of aggression than do the feminine characteristics of the woman (cf. Mead, 6).

The data of the present study are descriptive accounts of the aggression shown in two twenty-minute periods of doll play by 126 nursery school children, 66 boys and 60 girls. Half the children of each sex were from homes from which the father was absent, in most instances in military service. The data were collected between February and May, 1945. The analysis has been directed toward a discovery of uniformities in the children's reactions to the changed instigation consequent on their father's absence, the main emphasis being placed on relationships that appear to be connected with the sex-typing process.

Method

Subjects. The children used as subjects were of preschool age and all were enrolled in wartime Day Care Centers. There were 22 boys at each of three age levels, 3, 4, and 5 years, and 20 girls similarly distributed. Within each age and sex group, half the children were from homes from which the father was absent. There were, therefore, four main groups:

boys: father present (N = 33)
boys: father absent (N = 33)
girls: father present (N = 30)
girls: father absent (N = 30)

Each of these groups was composed of an equal number of children (11 boys or 10 girls) within each age bracket; they were matched by age in months.

The Day Care Centers provided all day care, six days a week, for the children of working mothers only. The 12 Centers were located in Des Moines, Cedar Rapids and Davenport, Iowa, and Rock Island, Illinois. Twenty-four of the boys and 25 of the girls were only children. For both father and mother of both sexes, the median grade of school (reported) completed was the twelfth.

Materials. The doll play equipment[2] consisted of furnishings for a six-room house, including a living room, dining room, kitchen, two bedrooms, and a bathroom. The miniature furniture was proportional to the size of the dolls used, and was realistic and colorful in appearance. When presented to the child, the materials were organized to represent a conventional house, with beaver board walls indicating the boundaries of the house and the location of the various rooms. When organized, the set measured 32 inches in length and 25 inches in width. However, none of the equipment was stationery; walls and furniture could be reorganized as the child wished. The dolls were placed in a row before the house.

Dolls representing a mother, father, preschool-aged boy and girl, and a baby, were used. The adult dolls were approximately 5 1/2 inches in height, the boy and girl, 3 1/2 inches, and the baby, 1 1/2 inches. The dolls were lifelike in appearance and dressed in suitable clothes.

Procedure. Each subject received two twenty-minute sessions of doll play. Usually these sessions were presented on consecutive days, though in nine instances one day elapsed between sessions.

When the subject was brought into the room, the materials were in view on the floor. The experimenter (M. H. P.) led the child over to them, and sat down on the floor with him in front of the set. The experimenter then said, "See all the toys I have - here's a whole house, isn't it?" Each room was named and pointed out to the subject, and then the experimenter said, "Now, here are the people who live in the house - here's the mother, the father, the little girl, the little boy, and the baby. You can make them do anything you want. You go ahead and play with them any way you like." Scoring was then begun and continued for 20 consecutive minutes.

If the subject asked the experimenter what she was writing on the paper, the experimenter said, "I'm just keeping track of the dolls and furniture this way. I keep track of the time, too" (gesturing toward stopwatch). Then she attempted to get the subject to return to the experimental task by saying, "What's going to happen next? What do they do?" and looked expectantly at the materials.

After the child began to play with the equipment, the experimenter's role was that of a very interested onlooker. The kind and amount of interaction between experimenter and child was maintained at the high level, as defined by Pintler (7). This consisted of 15 to 20 interactions with the child during each

[2] *Cf. Robinson (9) for a more detailed description.*

five-minute period. At no time did the experimenter suggest any specific doll actions or ask for or give interpretations, though by her encouraging remarks and continued attention to the child's play, she conveyed her interest and enthusiasm for what the child was doing.

At the end of the twenty-minute session, the experimenter said, "That was fine! You really know how to do it. Now, our time is up for today, but maybe you'll have another turn later."

Scoring and Categories. In addition to conducting the doll play session, the experimenter recorded all instances of aggression. Aggressive acts were defined as those having the intent to injure, punish, destroy, or generally disparage and depreciate. If a doll character was described as having an aggressive-hostile nature, attitude, or mood, such descriptions were recorded as aggressive units. The doll characters, the equipment, the experimenter, or the experimental room might be involved in the aggression.

By the use of symbols and arrows, the characters involved in any aggressive act as initiators or recipients of the aggression were indicated. In addition, a brief description of the nature of the aggressive act was recorded. For this purpose, the following symbols were used.

M	mother	O	generalized catastrophes such as storms, bombings, etc., and imaginary characters such as witches, Indians, wolves, rats, etc.
F	father		
B	boy		
G	girl		
bb	baby		
s	subject		
e	experimenter	→	direction of aggression
eq	equipment		

The following notation, for example, means that the boy doll was fighting and pushing the girl doll. The aggression was being expressed by the boy toward the girl.

B → G fighting, pushing

Other illustrative examples are as follows:

M → B	puts him to bed (The mother doll punishes the boy doll, for something he had done, by putting him to bed)
O →	storm blows house over (An imaginary evil and aggres-

		sive agent, the storm, destroys or injures something; no personal recipient indicated)
O	→ B	storm drowns him (Similar, but one of the dolls is the recipient)
F	→	"he's mad!" (A quotation by one of the other dolls; indicates the presence of hostility in the father doll)
S	→ F	"I don't like him." (The subject showed a hostile attitude toward the father doll)
S	→ eq	knocks over all the furniture (Tangential aggression)
O	→ e	subject in role of wolf, "I'm going to eat you up." (Aggression at a fantasy level, but directed toward the experimenter)
G	→	jumps on piano, table, chair (An outburst of aggressive behavior by the girl doll)
M	→ F	"Why don't you make those children behave?"
	→ M	"She's gotten sick." (A comment by the subject, but no indication of a specific agent of the sickness)
	→ bb	jammed down toilet (Subject may have been initiator, but not entirely clear from context; possibly another doll did it)
MF	→ BGbb	simultaneously jump on children who are piled on floor.

An aggressive act (or acts) was considered as one unit until some relevant change in person or method of expressing aggression was noted, or a definite break in the sequence of aggression occurred. For example, if the boy doll hit the girl again and again it was recorded as one unit. If he then picked up a chair and threw it at her, a new unit of aggression was recorded since the method of expressing the aggression had changed, although the person remained the same. If the boy and

girl were fighting and hitting each other, two units of aggression having different initiators and recipients were recorded. If this interchange of hitting continued, no new units of aggression were recorded, since the same method of aggressive action was continuing and the directions of it had been indicated for each doll involved.

If a definite break in a sequence of aggression was noted, such as cessation of the aggression for several seconds, the performance of an unaggressive doll act, organization of the materials, or conversation with the experimenter, and then the same sequence of aggression was resumed, it was recorded as a new unit.

Verbal aggression which served to illustrate or elaborate an aggressive act which was occurring was not scored separately. However, if there was no behavioral expression of the aggression which was being verbally expressed, then the verbal aggression was scored as a unit.

All aggression during the doll play sessions, irrespective of its mode of expression, can be considered as originating in the subject and being initiated by him. But in the scoring system, a distinction was made between that type of aggression which came directly from the subject and was directed to the dolls, equipment, or the experimenter without any known story component, and that which was expressed through the medium of the doll characters.

Only such acts of aggression as biting or twisting the dolls, pounding them with a piece of the furniture, a comment by the subject such as "I don't like that doll," or hitting the furniture or experimenter, were scored as aggression direct from the subject. Where any story component to the aggression could be recognized, the subject was not indicated as the initiator of the aggression. In such instances, the doll characters who initiated or received the aggression were recorded if it was possible to identify them, and if it was not possible to identify the initiator, then only the recipient was indicated.

In general, a unit of aggression was recorded for each doll involved, but where, as a group, two or more dolls were used in a concerted aggressive attack of a physical nature against another doll or dolls, the equipment, or experimenter, this was recorded as a group action.

In addition to the aggressive acts themselves, a record was kept of the time at which aggression first occurred and of the amount of interaction between experimenter and child. The end of each five minute period of the session was also indicated.

Reliability. To determine the reliability of this method of recording, two observers independently scored all aggressive

acts during 18 half-hour periods of doll play. Approximately 460 units of aggression were recorded during this time. Each session was conducted by M. H. P., who also recorded; the other observer sat behind a one-way screen, or in the same room at some distance from the child, and scored independently.

Both boys and girls were used in this reliability group, and their ages covered the range from three to six years.

Reliability was computed by means of percentage of agreement between the two observers; the formula is:

$$\frac{2 \times \text{No. of Agreements of A and B}}{\text{Total of A} + \text{Total of B}}$$

In order to constitute an agreement, not only the same content of the aggressive act had to be recorded by the two observers, but also the exact direction of the aggression in terms of initiator and recipient.

Reliabilities for these 18 sessions ranged from .0 to 1.00. The extremes were found in those sessions in which very few instances of aggression occurred. Total reliability was .82.

Results

Frequency of aggression

One measure of the strength of instigation to aggression is the frequency with which such acts occur spontaneously. Since the father's absence from the home represents a direct frustration to the child and a source of strain for the mother, and hence an additional though indirect possibility of mother — child frustrations, it might be anticipated that the father-absent children would show more frequent aggression in their doll play than the father-present children.

The relevant findings are presented in Table 1. Data for boys and girls are separated, since it has been shown (8) that average frequency for girls is much less than for boys.

Table 1. Mean frequency of total aggression by all boys and all girls with father present or absent, together with differences between groups.

Father Status	Boys			Girls			Diff.	C.R.	L. of C.
	N	Mean	S.D.	N	Mean	S.D.			
Father present	33	29.9	24.9	30	8.1	11.2	21.8	4.6	< 1%
Father absent	33	18.2	22.1	30	9.6	10.1	8.6	2.0	5%
Difference		11.7			1.5				
Critical Ratio		2.0			.5				
L. of C.		5%			N.S.				

Clearly, the prediction is not substantiated. The girls from the father-present and father-absent groups did not differ significantly, and the boys showed the exact opposite of the predicted relationship - the father-absent group was less frequently aggressive than the father-present.

In view of the many other consequences of father-separation, it is evidently an over-simplification to interpret the fatherless home as merely frustrating and to expect a gross increase in aggression. Two hypotheses suggest themselves. The first relates to inhibition of aggression, by the mother, and the second to a delay and distortion in the sex-typing process.

Inhibition hypothesis

On the whole, girls are less aggressive both in doll play and in real life than are boys. If this difference continues into adulthood, and it is a popular supposition that it does, it would be expected that mothers are less tolerant of aggressive behavior than fathers. Not only would they provide little encouragement for it, but they would suppress it to some degree. It is hypothetically possible, therefore, that boys whose primary training was coming from women (mothers and teachers) would develop an inhibition of aggressive behavior. This would be reflected in the doll play as a lowered mean frequency of aggression in the group of boys with fathers absent.

Another consequence of such inhibition would relate to its release in doll play. It has been shown repeatedly (1, 4, 11) that lack of restraint by the experimenter leads the child to become more aggressive from session to session. If there were an unusual degree of inhibition in the father-absent group of boys, then, it would be expected that they would show a greater increase than the father-present group from first to second session.

Table 2. Mean frequency of aggression in first and second 20 minute sessions.

Father Status	Session I	Session II	C.R.	L. of C.
Boys				
Father present	11.4	18.5	4.6	< 1%
Father absent	7.9	10.3	1.4	>10%
Girls				
Father present	2.6	5.5	2.6	> 1%
Father absent	4.5	5.1	0.6	60%

In Table 2 are given the mean frequencies for all four groups in both sessions, and the significance of the differences. The results are entirely contrary to the prediction. For both sexes,

the father-present group have an increase in frequency of aggression at the second session that is reliable near the 1 percent level of confidence, while for neither of the father-absent groups is there a change having much of any significance.

These differences gain in importance if the data for each age are examined separately. In Table 3 are given the relevant levels of confidence. At both the early ages, the father-present group of boys show a very reliable increase; at five years the difference is less reliable but in the same direction. The father-present girls do not show significant increases when the small numbers of cases at each age level are considered separately.

Table 3. Reliabilities of differences in frequency of aggression between first and second sessions. All changes were increases except those marked with asterisk (*).

	Boys		Girls	
Age	Father-present	Father-absent	Father-present	Father-absent
3	> 1%	> 50%*	5%	> 20%
4	< 1%	> 20%	> 20%	> 10%*
5	> 5%	10%	20%	> 20%

This test of the hypothesis is not entirely critical, since it is conceivable that the inhibition was so strong that two twenty-minute sessions were insufficient to release it materially. The strength of inhibition would be determined by the characteristics of this situation as a learning situation; whether it would give rise to weak or strong inhibitions is a question that cannot be answered. It is interesting to note, nevertheless, that Jeffre (4) found relatively little increase in aggression, with a normal preschool population of above-average intelligence, after the second of four half-hour sessions. Provisionally, it would seem safest to conclude that, at least, there is no evidence in favor of the inhibition hypothesis.

Sex-typing hypothesis

The second possible interpretation of the lower mean frequency for the father-absent group relates to sex-typing. As has been suggested earlier, the father serves as one of the most important models for the young boy. Without his father in the home, a youngster must model his behavior after his mother and other persons who enter his orbit. This does not mean that a boy of three is forced entirely into feminine sex-typing, for one has but to examine the daily environment of any urban youngster to see that many others besides his parents can influence him. The younger ages, however, are more lim-

ited in their social contacts outside the home, and at best there is a delay in the child's opportunity to develop the sex-typing that would be going on continuously from birth if both parents were in the home.

According to this view, then, it would be expected that at the earlier ages sex differences would be less clearly established in children whose fathers were absent than in those whose fathers were in the home. The father-absent boys should be less aggressive than the father-present boys; the two groups of girls should not differ significantly from one another, however.

In Figure 1 are shown the mean frequencies of aggression for each of the three age groups, divided as to sex and fathers' status. The sex differences between boys and girls whose fathers were in the home are reliable at better than the 1 percent level of confidence in both the three- and four-year-old groups and at a little greater than the 5 percent level in the five-year-old. The relationships with the fathers out of the home are notably different, however. There is no sex difference at three years, an unreliable one favoring the boys at four years, and a larger one (2 percent l. of c.) in the same direction at five years.

None of the differences between adjacent age groups in any of the four groups is reliable, although an upward tendency for the boys of the father-absent group is apparently indicated. The difference between three and five years is significant only to the 10 percent level, however.

These findings follow reasonably well the predictions made from the sex-typing hypothesis: where the father is absent, in the earliest year (three) there is no sex difference comparable to that in children from normal homes, but the difference develops in the fourth and fifth years. Furthermore, the two groups of girls do not differ significantly from one another, while the father-absent boys are less aggressive than the father-present boys at both earlier years (l. of c. only 10 percent and >10 percent) but approximately equal by the fifth year. It is interesting to note, too, that the increase in frequency from first to second session, which was characteristic of the father-present boys, appears to be developing in the father-absent boys (Table 3); there was an insignificant decrease at three years, an insignificant increase at four, and an increase with 10 percent level of confidence at five. These changes are of little import by themselves, but the direction of change with age is similar to the changes occurring in total (2-session) frequency - that is, toward a similarity to the father-present boys.

These findings give some support to the interpretation in terms of sex-typing. The group differences are ones that might

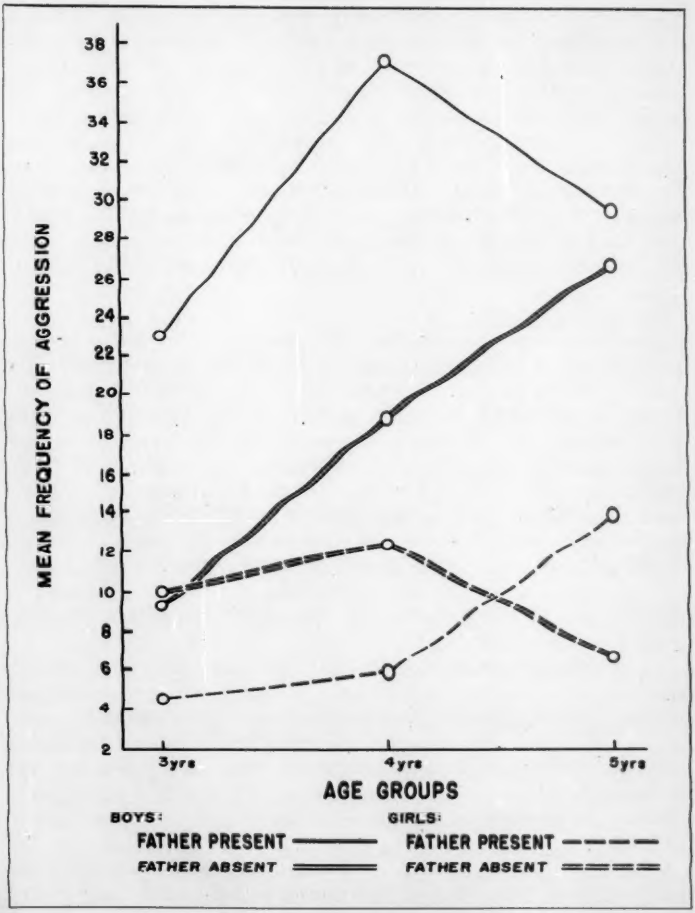

Figure 1. Total aggression. Mean frequency of total aggression by each sex with father present or absent.

be expected if the father serves as a model and a monitor for the son, providing a sample of greater aggressiveness than is found in the mother's behavior, and perhaps countenancing more overt aggression. When he is absent, the mother provides the chief learning experiences in these matters.

There are other aspects of the doll play, however, that must be examined before any very certain conclusion about these interpretations can be reached. For example, it is not immediately evident just what influence sex-typing or its distortion might have on the direction of fantasied aggression. Yet the identity of the person represented as agent or recipient of aggression must involve facts of considerable importance concerning the child's attitudes and his experiences with his family. The next section, therefore, presents an analysis of the data on direction, and is followed by a discussion of the sources of frustration which might account for the findings.

Direction of aggression

As was emphasized earlier, the absence of the father creates a different set of interpersonal relations within the family. The mother must necessarily take over some of the father's functions, inept though she may be because of her own sex-typing as a woman. Furthermore, she must play her own role without the supportive behavior of a husband. The complexity of the interactive behavior between a husband and wife is so great that it would be impossible, without an empirical approach, to hazard guesses as to the exact nature of the frustrations and gratifications that occur in either the presence or the absence of one member of the pair. It would be little more than idle speculation to try genuinely to "predict" the effects on children's fantasy behavior.

It is possible, however, that the opposite method of reasoning can be of value, that is, that the comparison of directions of doll play aggression by children living under these two contrasting conditions may suggest some of the functions the father serves. At least, such data can reveal who, on the average, are the most frequent agents of aggression in the child's experience, and toward whom he has the most frequently effective instigation to fantasy aggression.

Boys. In Table 4 are given the average frequencies, for the two groups of boys, of aggression expressed by and toward each of the dolls and other possible initiators or recipients. Subject refers to the child himself; O-catastrophes refers to wolves, ghosts, storms or other imaginary items; group of dolls refers to more than one doll used at a time.

In every instance, the frequency was lower for the father-

Table 4. Boys: mean frequency of the use of each doll or other agent as an initiator or recipient of aggression.

	Father present N = 33	Father absent N = 33	Diff.	C.R.	L. of C.
Initiators					
Subject	0.94	0.94	0	0	
O-catastrophes	2.24	1.70	0.54	0.57	
Mother	2.61	1.36	1.25	1.61	
Father	2.82	1.58	1.24	1.47	
Boy	2.70	1.21	1.49	1.93	5%
Girl	2.06	1.00	1.06	2.04	5%
Baby	1.12	0.88	0.24	0.55	
Group of dolls	0.18	0.09	0.09	0	
Recipients					
Subject	0.06	0	0.06	0	
O-catastrophes	0.61	0.18	0.43	1.13	
Mother	3.64	3.36	0.28	0.19	
Father	4.82	5.09	1.73	0.97	
Boy	4.64	1.67	2.97	5.61	<1%
Girl	3.42	1.55	1.87	2.26	2%
Baby	3.12	1.64	1.48	1.71	
Group of dolls	0.97	0.55	0.42	1.55	
Experimenter	0.06	0	0.06	0	
Equipment	1.91	1.09	0.82	0.85	

absent group, but these differences were by no means of equal size. In four of the 18 items the difference was great enough to give a 5 percent or better level of confidence. All four relate to the boy and girl dolls; both as initiators and recipients they were used less frequently by the father-absent group.

The implications of this rather curious finding become more apparent when the data are examined for each age group separately. In Figure 2 are shown the average frequencies of the mother, father and boy dolls used as recipients. The girl doll has not been plotted because the frequency does not vary a great deal from age to age for either group.[3]

It is evident that the massing of the ages, as in Table 4, hides some important variations. At age three, there is little or no difference among the dolls for either group, although the two groups are well separated, with the father-absent group lower than the father-present. By five years, however, the position has been reversed for the mother doll; in the father-absent group she is the highest recipient, and in the father-

[3] Values for the girl doll as recipient are as follows:

	3 yrs.	4 yrs.	5 yrs.
Father present	3.2	4.0	3.0
Father absent	1.1	1.2	2.4

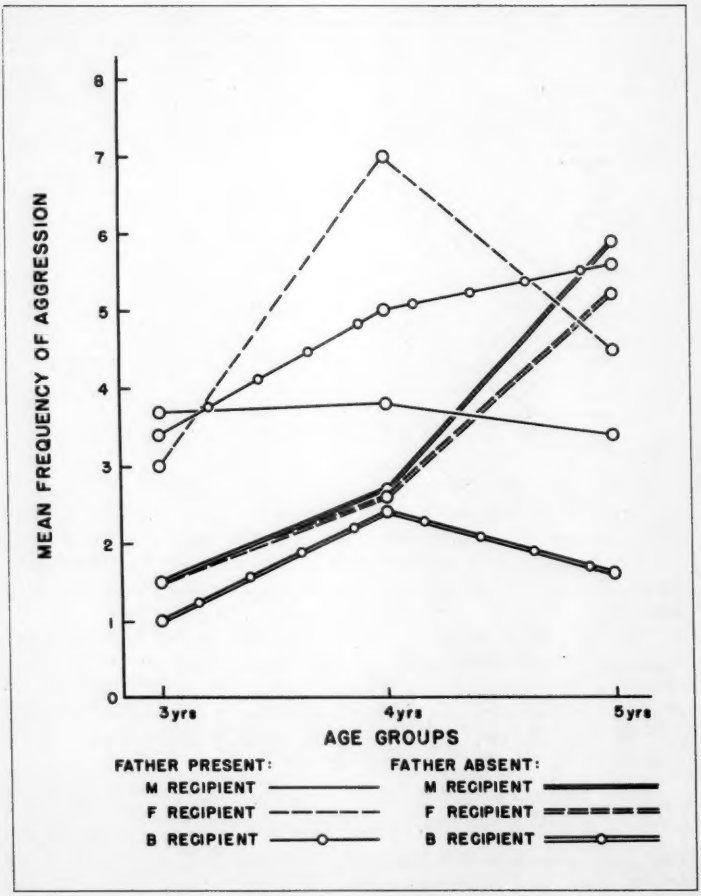

Figure 2. Boys: recipients of aggression. Mean frequency of mother, father and boy doll as recipients of aggression by boys with father present or absent.

present group she is the lowest. The increased use of the mother doll from the three to the five year level, in the father-absent group, is significant at the 5 percent level. There is practically no change with age in the father-present group.

The frequency of using the father doll as a recipient follows an age curve similar to that of the mother in the father-absent group, but goes to a much higher level at four years in the father-present group. Neither the differences between the two groups at individual ages nor the increase from three to five years in the father-absent group are significant at better than the 10 percent level, however.

The two groups differ considerably, also, in the frequency with which the boy doll is used as a recipient. This is especially apparent when a comparison is made of the trend with age. In the father-absent group, the parent dolls increase in frequency from three to five years, while the boy doll stays the same. In the father-present group, the mother doll stays the same and the boy doll rises; the father doll also rises at four years but drops down somewhat at five. The boy doll difference between the two groups at the five year level is significant between the

Table 5. Girls: mean frequency of the use of each doll or other agent as an initiator or recipient of aggression.

	Father present N = 30	Father absent N = 30	Diff.	C.R.
Initiators				
Subject	0.17	0.63	0.47	1.73
O-catastrophes	0.30	0.40	0.10	0.27
Mother	0.83	0.83	0	0
Father	0.83	0.53	0.30	0.80
Boy	0.70	0.53	0.17	0.51
Girl	0.83	0.50	0.33	0.94
Baby	0.87	0.47	0.40	0.98
Group of dolls	0.13	0.03	0.10	0.77
Recipients				
Subject	0	0.07	0.07	0
O-catastrophes	0	0	0	0
Mother	0.93	1.40	0.47	1.15
Father	0.77	1.30	0.53	1.08
Boy	0.67	1.37	0.70	1.59
Girl	1.23	1.30	0.07	0.13
Baby	1.57	0.37	1.20	1.90
Group of dolls	0.17	0.37	0.20	0.71
Experimenter	0.07	0	0.07	0
Equipment	0.07	0.46	0.39	0.33

2 percent and 5 percent levels of confidence, and the change in relative position of the boy and mother dolls, from ages three to five, is significant at much better than the 1 percent level of confidence.[4]

The possible implications of these age changes will be considered in the discussion below.

Girls. In Table 5 are given the mean frequencies of each initiator and recipient for the two groups of girls. In no instance is there a significant difference between the groups. Again the analysis of recipients by age groups shows some interesting trends, although the total number of aggressions was so small, and the zero scores so frequent, that none of the differences between groups at a given age or between ages of a given group has statistical significance.

Figure 3 shows the average frequencies of mother and father dolls as recipients, and Figure 4 shows the boy and girl dolls. It appears that none of these recipient frequencies is entirely independent of age. Unlike the boys, however, the girls had greater variability among the dolls at three years and, with the exception of the boy doll in the father-absent group, all the dolls are approximately equal for both groups at five years. This trend is consistent at the four year level for seven of the eight curves.

Discussion

The father's role. The data of this study are limited to aggression and hence do not give a complete picture of the children's fantasies about home life. Within the limits so imposed, however, certain facts emerge that have some importance for an understanding of the role the father plays, both when he is present in the home and when he is absent.

It seems evident that during the preschool years he contributes heavily toward the sex-typing of boys in respect to their expression of aggression. How he does this remains to be discovered. Probably he serves as a model, a more aggressive model than the mother. Possibly, too, he provides a more permissive environment for aggression. In any case, his absence leads to a reduction in the frequency of such actions in doll play,

[4] *This statistic was obtained by a t-test of the difference between the two groups with respect to the frequency-of-boy minus frequency-of-mother in the five year groups. Of the 11 boys of the father-absent group, only one had more boy- than mother-recipient instances, and of the 11 boys in the father-present group, only one had more mother- than boy-recipient instances.*

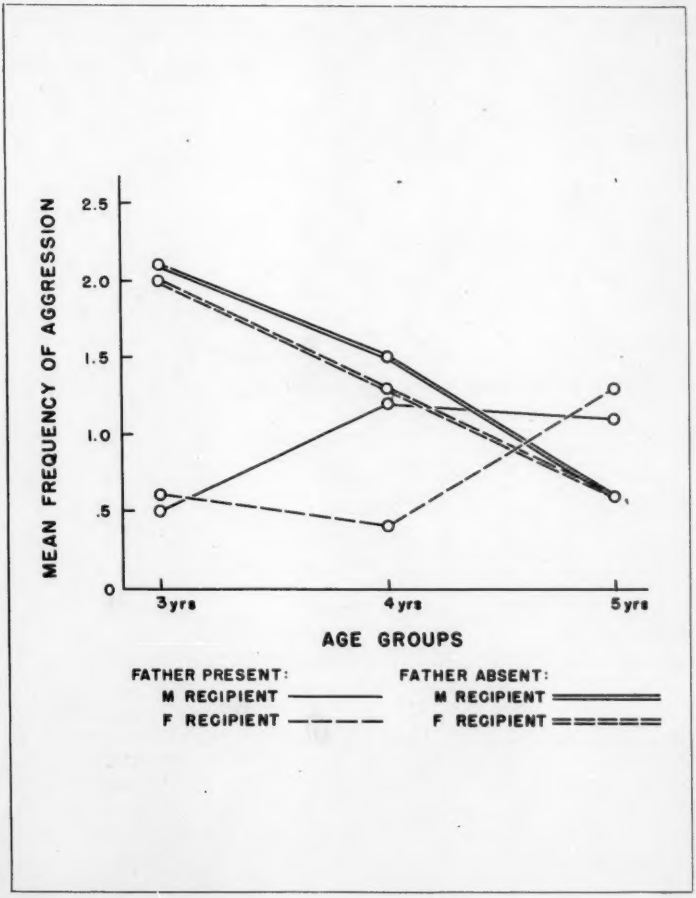

Figure 3. Girls: recipients of aggression. Mean frequency of mother and father dolls as recipients of aggression by girls with father present or absent.

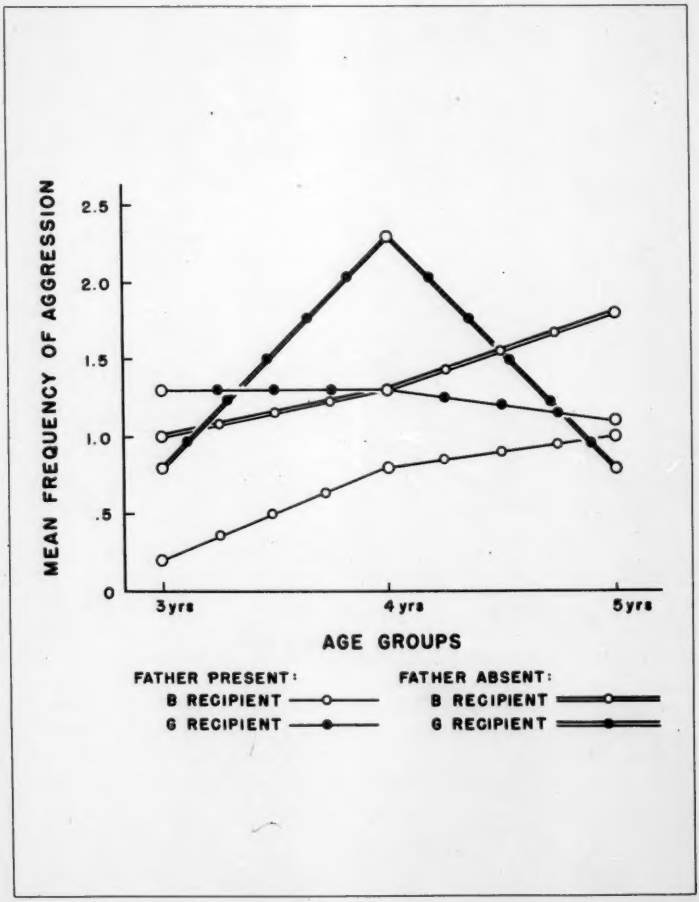

Figure 4. Girls: recipients of aggression. Mean frequency of boy and girl dolls as recipients of aggression by girls with father present or absent.

and there is no evidence that this results from any special suppression by the mother. Further substantiation of this reasoning comes from the decreasing effect of father-absence as the children get out into more social contacts (i.e., the older they are).

When the data on recipients of aggression are examined, however, still another factor seems to be introduced. The father's greater aggressiveness apparently operates as a frustration, at least to his son. The reason for thinking this is that when the father is absent, the boy shows equal aggression toward both parent dolls; when he is present, there is greater aggression toward the father doll than toward the mother. Furthermore, there is a strong suggestion that the father exercises a more rigid control over the boy than does the mother; with the father present, boys express a very marked aggression toward the boy doll, while his absence is associated with very low boy doll aggression. The high boy doll aggression may well represent self-aggression, which is a likely consequence of too strict paternal control (cf. Levy, 5, p. 199). It appears, then, that the father serves not only as a model but also as a frustrator whose control over the son leads the boy to fantasied self-aggression as well as to father-directed aggression. In the absence of the father, this self-aggression is not prominent, but both parents share equally in direct aggression which reaches its peak at five years.

Two other aspects of the data suggest that this father-frustration may be related to the emotional developments commonly discussed in connection with the Oedipus situation. First, the relations described above are most pronounced during the fourth and fifth years. The younger boy does not react with differential amounts of aggression toward the two parents, but as he gets older and more aggressive, he comes into more conflict with his father. The sources of such conflict may be various. If the father is serving as a model, the son will imitate him, and the father, possibly feeling guilty about his own aggression, will punish his son's aggressions. From a purely mechanical standpoint, the boy's increased aggressive behavior will be bound to impinge more and more frequently on the father, frustrating the latter more often, and thus elicit greater counter-aggression. The fact that the father is more permissive of aggression than the mother does not mean he is more tolerant of aggression directed toward himself; he is, if anything, less tolerant. But he is permissive with respect to the use of aggression as a solution of social conflict in the neighborhood, at school, and among siblings or animals in the home. Another possible source of conflict may be an increasing competition of the son with his father,

an Oedipus competition, but in the absence of evidence from the home itself, such an interpretation must remain purely hypothetical. It is interesting to note that even in the father-absent group there is an increase in aggression toward the father at the fifth year; this is parallel to the increase for the mother. Unfortunately the measure of aggression used with these data (frequency) does not enable us to distinguish between aggression caused by increasing social control, and that which might, hypothetically, be caused by fantasied competition, from the absent father, for the mother's affection and attention. The same anonymity of source exists for the father-directed aggressions of the father-present group. In any case, the result of the increasing conflict is probably greater paternal control, which serves not only to frustrate the son but to redirect some of the boy's aggression toward himself. This is a behavioral consequence of the kind observed by Freud, and on the basis of which he posited the Oedipus pattern of development.

Second, there is no indication that the girls are more frustrated when the father is present; on the contrary, his absence is associated with greater aggression, especially self-aggression (girl doll) during the fourth year. The girl appears to develop without special conflict with her father. Possibly it is the mother with whom she comes in more serious conflict. In any case, the father's absence leaves her free to develop under the mother's guidance, and it is in his absence that she shows an increase in self-aggression. In general, the data suggest that the parent of the same sex provides the greater frustration and the more rigid control.

These interpretations coincide fairly well with what is commonly believed to be typical of father-son and father-daughter relationships. The phrase "commonly believed to be typical" is especially significant. There are no adequate objective data that report the "typical" in-family behavior to be found in upper lower and lower middle class homes. It is questionable whether a clearly definable modal form could be discovered. Each family has its own structure, its own dominances, social tensions, disciplinary forms, dependencies and other emotional relationships that finally determine the role each member plays and the frustrations or gratifications produced by his presence or absence. Only to the extent that cultural uniformities do exist can data such as those from the present study be expected to present invariable and consistent relationships.

Measurement of aggression. The interpretative approach of this study has been toward discovering not only the father's role in relation to his child but the nature of the child's aggressive motivational systems as they are influenced by the father.

This has led to conclusions couched in terms of an intervening variable, strength of instigation to aggression, the operational measure of which has been frequency of differentiable aggressive fantasies. Whether this measure is the most suitable for investigating the quantitative properties of aggression may be questioned, but whatever conclusion is reached, the assumptions underlying it deserve explicit statement.

It is supposed that a child possesses an unknown number of potential responses to each object with which he comes in contact. These make up his repertory of actions that can be elicited by the stimulus properties of the object. The member-responses of this repertory are of unequal strength and stability, however, and they form a hierarchy with respect to their probability of occurrence on any given presentation of the object. The origin of this hierarchical characteristic lies in a number of factors, such as frequency of previous reinforcements and number of facilitating drives or instigators operative at the moment of presentation.

It is further assumed that some of the responses in a given hierarchy are incompatible with one another, so that if one occurs certain others cannot. Whether the incompatibility is of central or peripheral origin makes no difference; the significant point is that there is a series of potential incompatible responses of different strength.

The measurement of strength of instigation by frequency of occurrence rests on the proposition that the stronger the drive, the more frequently will the drive-instigated response compete successfully with the other potential responses elicitable by the object. This proposition, in turn, rests on the assumption that each occurrence of a drive-instigated act reduces the immediate strength of that drive, and that successive reductions are cumulative in their effect. Hence, the drive strength is eventually reduced to a level at which it is less than that of other, coexisting, drives.

In the doll play situation, for example, the father doll may serve as a stimulus object. There are several potential responses the child may make to him, affectionate approach, supplication, aggression, inquiry, and so on. Each of these actions is a member of the hierarchy. Each is repeatedly being instigated by the father doll. Since the experiment is designed to hold constant all other sources of instigation to each of these responses, only drive strength can vary, and hence determine which response occurs. Once any of the actions has occurred, there is again a free situation in which all have an equal chance. If the aggressive drive is high, the aggressive action will occur not only once but many times. If it is low, the partial reduction

in drive strength caused by the first few occurrences will have allowed the total strength of instigation to aggression to drop lower than the strength of instigation to one of the other actions. The repeated reductions in drive strength, resulting from occurrence of goal responses (fantasied aggressive acts, etc.), provide for fluctuation in drive strength. It is assumed that the greater the initial strength, the more acts will be required to reduce it to a point at which it competes unsuccessfully with other simultaneously operative drives.

Other possible measures that might be used are latency of first aggressive act, duration of actions, and type of action (cf. earlier discussion of kind as a measure of intensity). The logical support for these measures is more difficult to trace, however, and there are other psychological variables that are known to influence them to a considerable extent. For example, the degree of inhibition of aggression is important in determining latency. Duration is difficult to measure and is sensitive to momentary changes in the attitude of the experimenter. Too little is known about factors determining type of aggression to permit, at present, the construction of the necessary scale of seriousness that would reflect intensity.

SUMMARY

Two twenty-minute projective doll play sessions were secured from 126 children enrolled in Day Care Centers. The group was composed of 66 boys and 60 girls, each sex evenly distributed among three ages, three, four and five years. Half the children of each sex and age level were from homes in which the father was present, and half were from father-absent homes. Descriptions of all doll play aggressions were recorded. These data were analyzed, in terms of frequency, with reference to age and sex differences as these related to the presence or absence of the father. The following conclusions were reached:

1. Boys from father-absent homes portrayed much less fantasy aggression than boys from father-present homes.
2. Girls from father-absent homes portrayed slightly, but not reliably, more aggression than girls from father-present homes.
3. Neither boys nor girls from father-absent homes portrayed the customary sharp rise in aggression frequency on the second doll play occasion. The rise did occur in the father-present groups.
4. The direction of aggression toward the various members of the doll family indicated:
   a. greater aggression toward the father, by boys, when

he was present than when he was absent

b. greater aggression toward the father than toward the mother, by boys

c. greater aggression toward the boy doll, by boys, when the father was present than when he was absent

5. The findings have been interpreted in terms of sex-typing and the frustrating and rewarding roles of the parents in their home relationships with the children.

REFERENCES

(1) Bach, G. R. Young children's play fantasies. Psychol. Monogr., 1945, 59, No. 2, 1-69.

(2) Bach, G. R. Father-fantasies and father-typing in father-separated children. Child Develop., 1946, 17, 63-80.

(3) Dollard, J., Doob, L. W., Miller, N. E., Mowrer, O. H., and Sears, R. R. Frustration and aggression. New Haven, Yale University Press, 1939.

(4) Jeffre, M. Fantasied mother-child interaction in doll play. Unpublished dissertation. University of Iowa Library, 1946.

(5) Levy, D. M. Hostility patterns in sibling rivalry experiments. Am. J. Orthopsychiat., 1936, 6, 183-257.

(6) Mead, M. And keep your powder dry. New York, Morrow, 1943.

(7) Pintler, M. H. Doll play as a function of experimenter-child interaction and initial organization of materials. Child Develop., 1945, 16, 145-166.

(8) Pintler, M. H., Phillips, R., and Sears, R. R. Sex differences in the projective doll play of preschool children. J. Psychol., 1946, 21, 73-80.

(9) Robinson, E. F. Doll play as a function of the doll family constellation. Child Develop., 1946, 17, 99-119.

(10) Spence, K. W. The nature of theory construction in contemporary psychology. Psychol. Rev., 1944, 51, 47-68.

(11) Yarrow, L. The effect of antecedent frustration on projective doll play. Unpublished dissertation. University of Iowa Library, 1946.

A NOTE ON THE COMPARATIVE MOTOR ABILITY OF NEGRO AND WHITE TENTH GRADE GIRLS

ANNA ESPENSCHADE
University of California, Berkeley

In a recent program of testing at an Oakland, California, high school, the Brace Test (1) of motor ability was given to all tenth grade girls who were physically able to participate at the time of testing. The Brace Test consists of a series of stunts of varying degrees of difficulty. It is designed to measure such aspects of general bodily coordination as agility, flexibility, balance, strength and control. The girls were tested in groups of 6 to 10 and all scoring and recording was done by the author.

The influx of Negroes into Oakland during the war has had a marked effect upon the school population. Of the tenth grade girls tested in the Fall of 1944, nearly one-third were Negro.[1] Although the total number of cases is small, the lack of studies (3) on the gross motor ability of Negroes made it seem worth while to report the results obtained.

Thirty-five Negro girls were matched with an equal number of white girls on the basis of age, weight and height. On the average, Negro girls in the tenth grade are a half year older than whites, weigh slightly less, and are approximately equal in height. (Table 1.) These results are in accord with those of other investigators (2, 4, 5) who report that the Negro tends toward a somewhat more slender build than the white. No difficulty was experienced in this study in pairing Negro with white girls for weight and height, but some 6 of the Negroes were older than any white girl in this grade.[2]

The average total score on the Brace Test for the whites was 11.37, for the Negroes, 10.65. This difference is not significant; the P value falls at the .70 level of confidence. An examination of the significance of the differences between the percentages of girls passing each test suggests that the whites tend to be superior in balance, while the Negroes show greater arm strength. (Table 2, Figure 1.) In only two tests, however, are differences significant at the .01 level of confidence: test 18, balance with eyes closed and test 17, a measure of leg

[1] *Any girl who had Negro blood and who was considered a member of the Negro social group was classed as Negro. No attempt was made to estimate the degree of racial purity of the subjects.*

[2] $\frac{\text{Mean of differences, white-Negro}}{\text{Sigma of mean of differences}}$ Age .34 P .73

strength, control and flexibility.

Of the Negro girls tested, 21 attended junior high school in the San Francisco Bay area or in Los Angeles and 14 had recently come from other states. As physical education programs differ markedly in different states, the performance of these two groups of Negroes was compared to determine possible effects of previous training. The mean Brace score for the California Negroes was 10.67, for the others, 10.64. Table 3 shows that each of the Negro groups tends to excel the other in a few tests but no differences are significant and no consistent pattern which might be attributed to any specific cause emerges. On two tests, differences between the Negro groups are as great as or greater than those between Negroes and whites.

The results indicate that white girls tend to be superior to Negro girls in balance. Since this conclusion rests upon a few measures, scored either "pass" or "fail" and hence of low reliability, it must be interpreted with caution. Further study is needed in this area.

REFERENCES

(1) Brace, D. K. Measuring motor ability. New York, A. S. Barnes and Co., 1927.

(2) Lloyd-Jones, Orren. Race and stature: A study of Los Angeles school children. Research Quart., 1941, 12, 83-97.

(3) Rhodes, Adele. Comparative study of motor abilities of Negroes and Whites. Child Develop., 1937, 8, 369-371.

(4) Royster, L. T. Body type of Negro children. Arch. Pediat., 1936, 53, 259-266.

(5) Steggerda, Morris. Physical measurements on Negro, Navajo and White girls of college age. Am. J. Phys. Anthropol., 1940, 26, 417-433.

TABLE 1

AGE, WEIGHT AND HEIGHT OF NEGRO AND WHITE GIRLS

		Age (years)		Weight (pounds)		Height (feet)	
	No.	Mean	S.D.	Mean	S.D.	Mean	S.D.
All Whites	70	15.3	.56	131.1	20.5	5.39	.43
Negroes	35	15.8	1.05	127.8	16.9	5.36	.42
Whites, matched cases	35	15.5	.55	127.6	17.0	5.38	.42

TABLE 2

SIGNIFICANCE OF THE DIFFERENCES BETWEEN PERFORMANCES OF NEGRO AND WHITE GIRLS ON CERTAIN BRACE TESTS

C R *	No. of Test **	Analysis of Test
2.50	18	Balance (eyes closed)
2.50	17	Leg strength, control, flexibility
1.75	7	Agility and balance
1.20	16	Agility and balance
1.03	20	Leg strength, control, flexibility
.85	8	Agility
.78	15	Agility and balance
-.62	19	Arm and shoulder girdle strength, flexibility, balance
-.81	9	Leg strength, control
-1.67	5	Arm and shoulder girdle strength, control
-1.78	10	Agility, flexibility

* Positive numerals indicate white superiority.
** All other tests were passed by more than two-thirds of both groups.

TABLE 3

SIGNIFICANCE OF THE DIFFERENCES BETWEEN CALIFORNIA AND NON-CALIFORNIA NEGRO GIRLS ON CERTAIN BRACE TESTS

C R.*	No. of Test
-.92	18
-1.13	17
1.84	7
-.92	16
00	20
-1.07	8
.77	15
1.54	19
00	9
00	5
00	10

* Positive numerals indicate superiority of California Negroes.

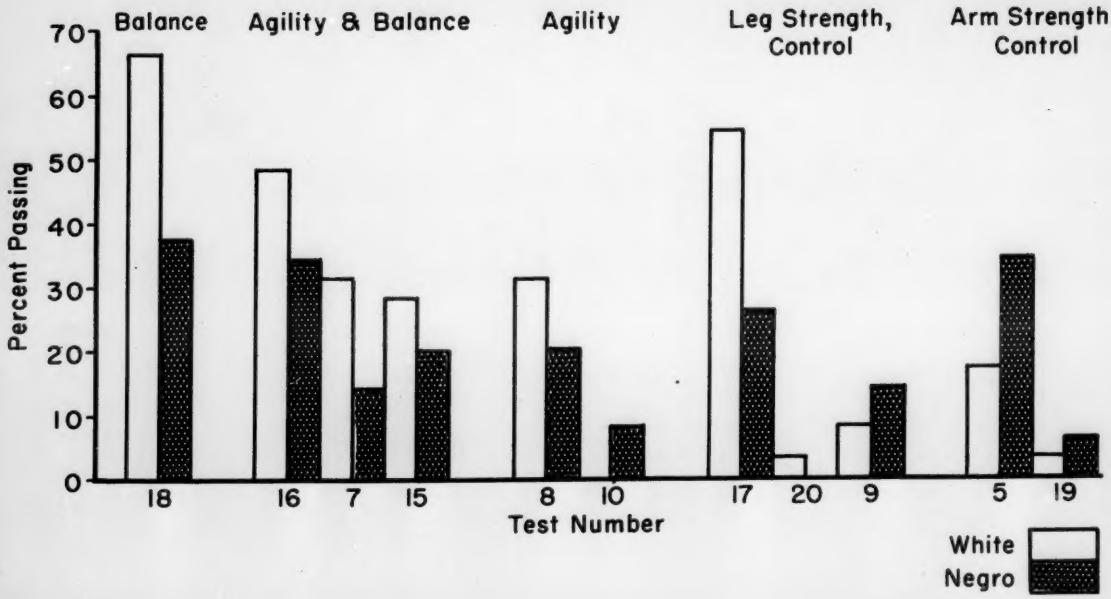

FIGURE 1. PERCENTAGES OF GIRLS PASSING CERTAIN BRACE TESTS

Contents for December

Information for Contributors and Subscribers

Child Development, one of three publications issued by the Society for Research in Child Development, is devoted to brief papers of current research in the child field. The journal is issued quarterly in March, June, September and December. The subscription price is $4.00 per year, postpaid. A limited supply of back issues is available at $1.25 per number. Until the supply is exhausted, complete sets, Volumes 1 to 15 inclusive, may be obtained for $30.00.

Other publications of the Society include *Child Development Abstracts and Bibliography* and *Monographs of the Society for Research in Child Development.*

Child Development Abstracts and Bibliography, now in its twentieth yearly volume, is issued February through December—six numbers to a volume. The subscription price is $5.00 per year, postpaid.

Monographs of the Society for Research in Child Development, issued irregularly during the year, consist primarily of detailed critical reviews and seriatim studies. The subscription price is $4.00 per yearly volume.

The three publications of the Society are available at the special price of $10.00 per year.

Correspondence relating to articles and papers for publication in *Child Development* should be sent to Dr. Carroll E. Palmer, Society for Research in Child Development, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

Correspondence relating to studies for publication in the Monograph Series should be sent to Dr. L. W. Sontag, The Samuel S. Fels Research Institute, Antioch College, Yellow Springs, Ohio.

Correspondence relating to subscriptions and business matters for all publications should be sent to the Editorial Office, Society for Research in Child Development, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.


C51